

# AGRICULTURAL ENGINEERING

APRIL • 1952

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A Study of Heat and Moisture Exchanges in  
Dairy Barns      *H. J. Thompson and R. E. Stewart*

The Evolution of the Newer Materials for  
Farm Tractors      *Stanley Madill*

Systems of Surface Drainage of Tight Soils  
in the Midwest      *Keith H. Beauchamp*

A Study of the Fundamentals of Infrared  
Brooding of Pigs      *J. G. Taylor, et al*

Heating Water with Milk Cooler Using Heat-  
Pump Principle      *L. F. Chaviry, et al*

*ASAE Annual Meeting • Kansas City, Mo., June 16-18*



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THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

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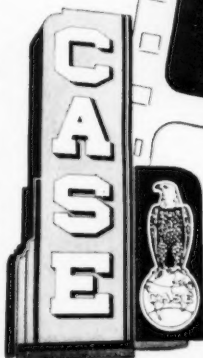


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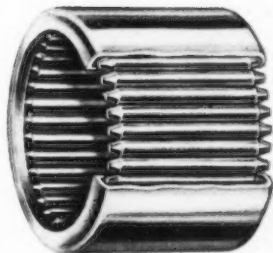


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# AGRICULTURAL ENGINEERING

Established 1920

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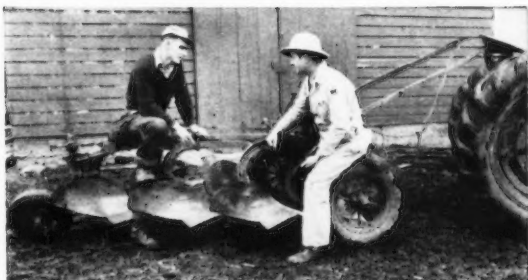
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"They sure can take it in hard plowing," Paul Frye (left) tells Walter J. Buege of Sheldon Implement Co., IH dealership at Sheldon, Ill., as they check wear on Spearhead points.



FROM GEORGE D. WILLIAMS,  
BROOK, INDIANA

"Last fall I plowed 30 acres of hard ground—silt loam and gumbo—with Spearhead points on my McCormick Plow Chief bottoms. Twenty acres were in alfalfa and clover, and 10 were in sweet corn ground. I compared the wear on Spearhead points with conventional shares. Based on actual field test comparison, I know that Spearhead points outwear and outlast conventional shares three to one."—George D. Williams.



"No more share sharpening for me," George D. Williams (left) tells Milton Storey of Baird and Storey Implement Co., Morocco, Ind., as they check performance of Spearhead points.

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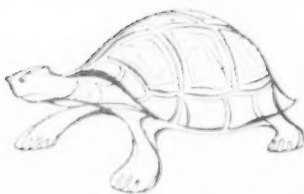
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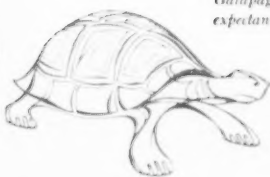
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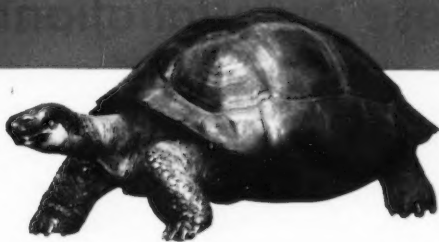


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dependability

low initial cost

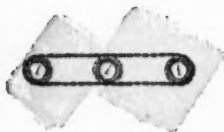


low overall cost

long centers



short

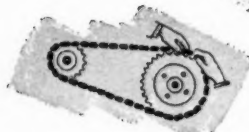


positive timing



heat

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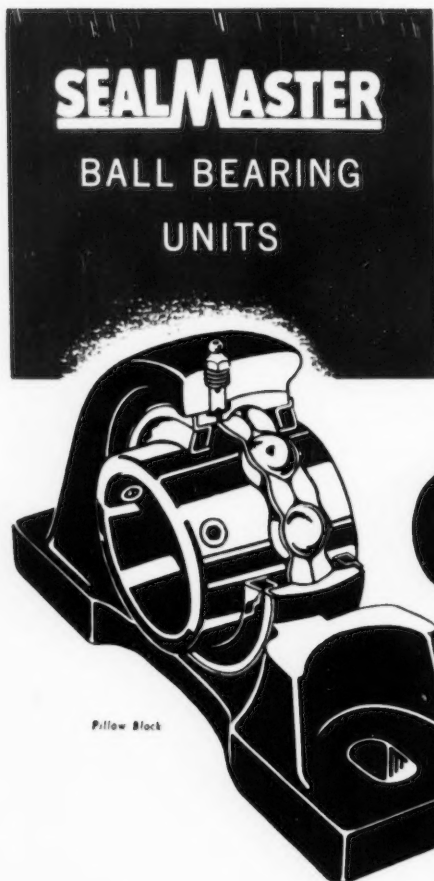
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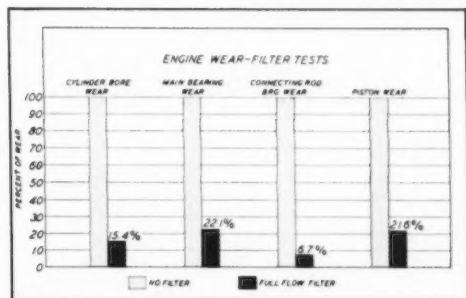
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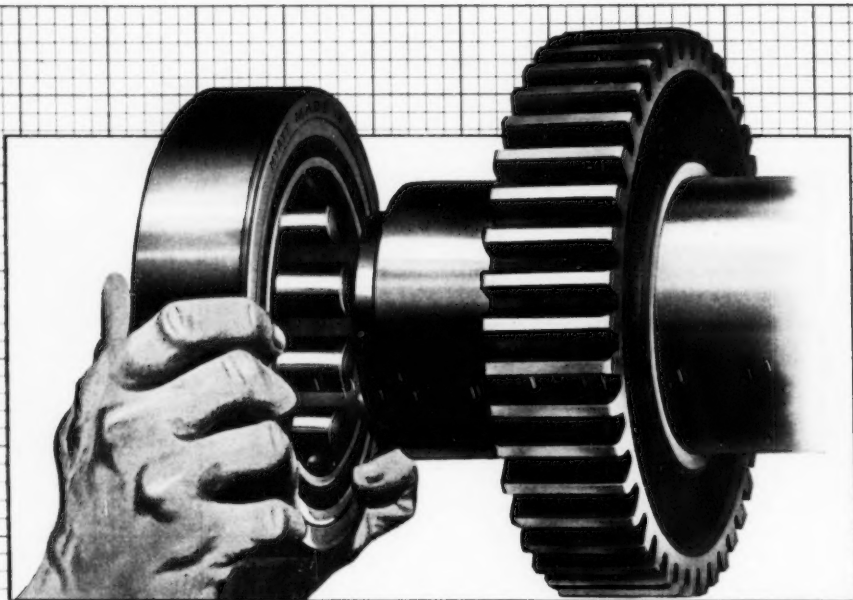


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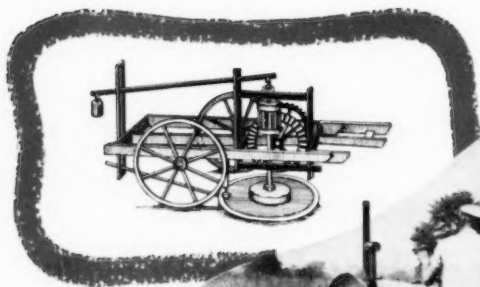
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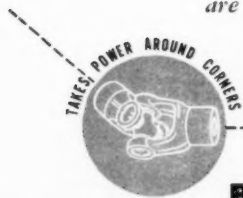
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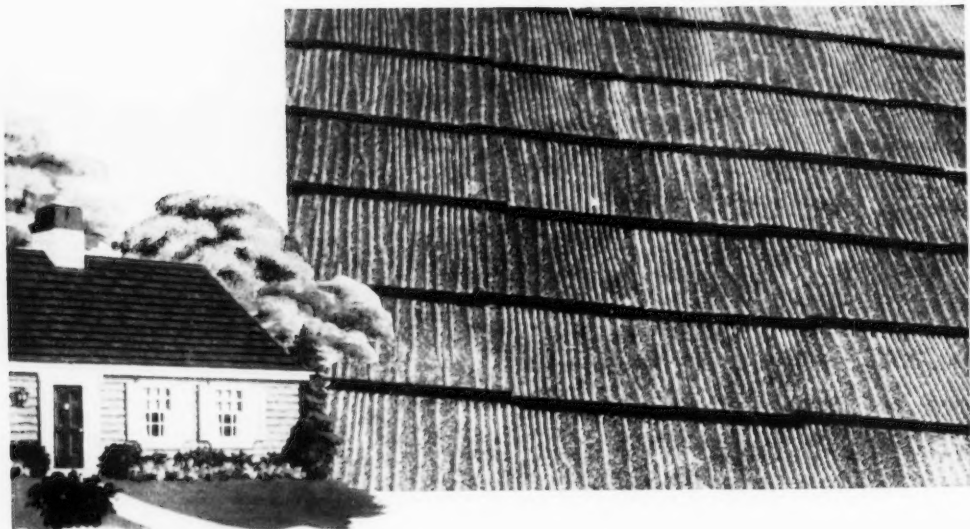
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AGRICULTURAL ENGINEERING for April 1952

195

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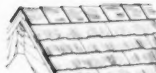
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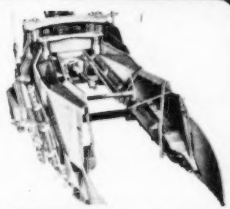
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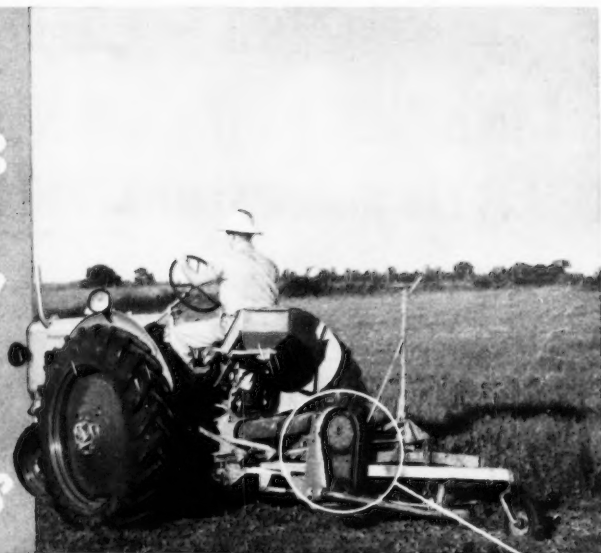


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## EDITORIAL

### Intercommunication Between Engineers

SCIENCE has been applied to the age-old problem of human organization to an extent which is beginning to give some preliminary indications of practical significance.

One such indication reportedly supports the conclusion reached by many engineers and others through the less scientific methods of personal experience and casual observation. It is the observation that the most effective exchange of information and ideas occurs in small groups of about six people, rather than in larger discussion groups or in audiences listening to a scheduled speaker.

Scientific support for this observation might well have a profound effect on the character of future engineering organization and engineering meetings.

For example, at ASAE meetings we have frequently heard remarks to this effect: The scheduled formal program provides official justification for travel and time used in attendance, but much of the advantage of attendance results from the informal give-and-take of information and ideas in small, spontaneous, unscheduled conversations which occur without benefit of official recognition.

A more open and general appreciation of this point might result in employers re-evaluating their investment in outside contacts. It might lead them to favor the use of travel budgets by engineers as well as by salesmen, on meetings providing maximum opportunity for a succession of close personal contacts with the right men.

It might lead to considerably increased emphasis, in the programming of engineering society meetings, on committee sessions, small group conferences, panel discussions, and free time, tied to a more concentrated nucleus of large group sessions with exceptionally capable speakers.

It might lead to engineering society programs designed in part to accommodate the expressed or implied desires of various members to talk over certain special subjects informally with a few others, with or without a small audience, in a succession of round-tables.

Under present and prospective pressures for performance, engineers seem due to become increasingly discriminating as to the number and character of occasions which will induce them to subject themselves to a large audience situation. The large audience has definite limitations as an environment in which to gain information. Engineers generally have little to gain by presenting themselves for a mass psychology treatment. They may, however, be expected to continue to patronize large gatherings where the subject matter and the speaker's viewpoint are of definite interest. A large audience is often a necessary concession to the limited time and energies of a speaker whom many people genuinely want to hear in person.

It appears that definite mathematical relationships comprehensible to engineers may govern the effectiveness of human organization and joint effort in engineering meetings and elsewhere.

The indicated ideal six-man relay for exchange of information and ideas may represent for most individuals a balance between listening time and contributing time which enables them to secure optimum value from a discussion. It may represent the approximate dimensions and distribution of knowledge which can be dealt with most effectively in one discussion. It may provide a unit with natural resonance in phase with individual rates of mental give-and-take.

Pipe lines of information and chain reactions of inspiration are of recognized importance to engineers. As proponents of efficiency, with a definite responsibility to advance "human well-being through engineered progress", engineers may be expected to show a strong lead in practicing the mechanics of effective human organization, as the principles involved are further clarified by science.

### Technical Competence

AT LEAST one large manufacturer has a leadership training program based in part on a recognition that a high degree of technical competence is required in some of its manufacturing activities.

It is a matter of common observation that agriculture, the agricultural sciences, and agricultural engineering are likewise becoming more highly technical and providing increased opportunity and rewards for technical competence.

Still there is a danger, in the pace of everyday living and taking many things for granted, of overlooking indications that technology has moved into a new era of increased importance in just the past few years since the nominal end of World War II.

Not only the United States but a large part of the world has become sold on technology. New generations see in a new light the results of technology. Many who do not understand its methods of operation look to it for further relief from their miseries, for daily comforts, for help in realizing their highest aspirations.

In a world frequently disillusioned with the performance of its human clay, the characteristic intellectual honesty, professional integrity and sharing of knowledge of the technical fields takes on new values.

Industry, government, and the very educational sources of technically trained men and women cannot seem to get enough of them.

The present commanding position of technology has not yet been made clear to the one-third of our young people potentially capable of earning some place in it.

Young people have a wide range of aptitude for various branches of science. Those aptitudes may be developed by a wide variety of training and experience over a long period of time, and find useful and profitable employment in a wide range of capacities, often beginning even before the basic training is completed.

Under present demand conditions there will be temptations to attract students without adequate checks on their aptitudes, to let down training and performance standards at all levels, and to hope for the best. That is not the way in which technology earned the respect it is currently accorded, and it offers little promise of meriting continued respect.

To young agricultural engineers, students and prospective students, their teachers, advisers, and employers, we venture this reminder: What the world wants is not merely men who have casually completed certain prescribed technical training. It wants high-grade performance, based on technical competence, including ability, knowledge, training, outlook, interest, willingness to work, intellectual honesty and professional integrity. In some of these qualities the beginner can be the equal of the most advanced men of science. In others, he can look forward to a lifetime of development.

### More Work for Farm Contractors

ANOTHER farm job is shaping up as a promising field for the farm power and equipment contractor. It is the handling and distribution of anhydrous ammonia fertilizer for farms not large enough to warrant individual ownership and exclusive use of the specialized equipment required.

For the many farms which cannot readily be expanded to individually provide full use for large-capacity equipment, the obvious and time-honored alternative is use of such equipment units beyond the boundaries of one farm.

In today's cash-basis farming, requiring a more accurate accounting of values than is provided by exchange of labor and equipment, that means custom operation. It has its limitations and disadvantages, but they are often a lesser evil than either excessive overhead or use of low-capacity equipment and increased labor. There are farm jobs for small, low-cost, low-capacity equipment units, but it appears that the distribution of anhydrous ammonia is not one of them.

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**Champions are**

**Made...**



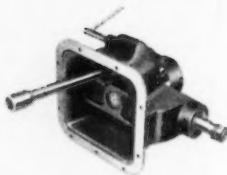
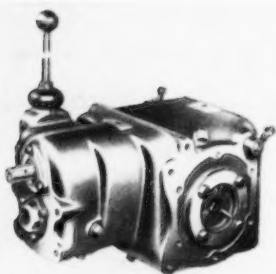
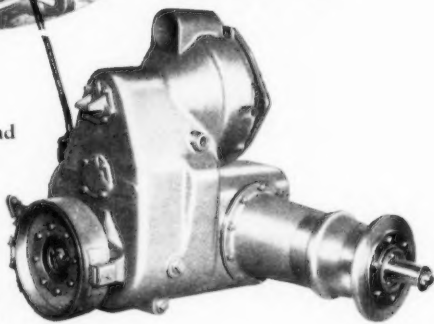
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# AGRICULTURAL ENGINEERING

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## Heat and Moisture Exchanges in Dairy Barns

By H. J. Thompson and R. E. Stewart

MEMBER ASAE

ASSOC. MEMBER ASAE

**T**HIS paper presents results of research done during 1948, 1949, and 1950 in the Psychroenergetic Laboratory at Columbia, Mo. The Laboratory is described in detail and measurements of over-all heat and moisture exchanges are shown and discussed.

A brief review of our Columbia, Mo., dairy cattle shelter studies and their objectives will be given for those who are not familiar with the project. It is a cooperative project that has

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1951, as a contribution of the Farm Structures Division. Approved by the Director as Journal Series Paper No. 1288 of the Missouri Agricultural Experiment Station. (The research reported in this paper is part of a broad cooperative investigation between the Departments of Agricultural Engineering and Dairy Husbandry of the Missouri Agricultural Experiment Station, and the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. Department of Agriculture. The USDA Bureau of Dairy Industry and Animal Industry advised with the BPISAE on various aspects of this work.)

The authors: H. J. THOMPSON, resident agricultural engineer (BPISAE), U.S. Department of Agriculture, and R. E. STEWART, instructor in agricultural engineering, University of Missouri, Columbia.

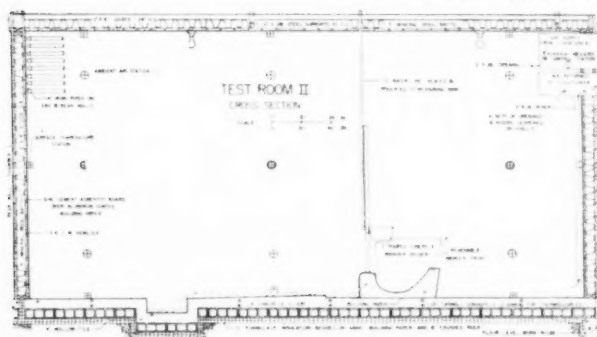
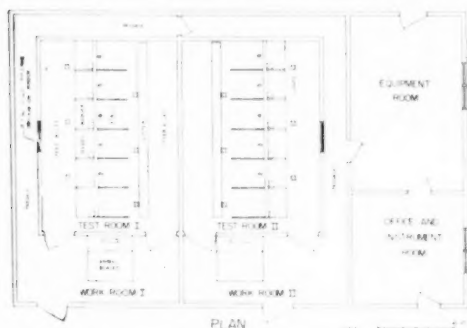


Fig. 1 Arrangement and construction details of the test chambers of the Psychroenergetic Laboratory at Columbia, Mo. Animals remained inside these chambers throughout test periods, except while being weighed.

been made possible by the support of the U.S. Department of Agriculture, Missouri Agricultural Experiment Station, Office of Naval Research, Atomic Energy Commission, and Mineral Wool Association. Our objectives are to study the effect of environmental variables, such as temperature, humidity, air movement, and light upon milk production, feed and water consumption, body weight, physiological responses, and heat dissipation or ventilation characteristics of a shelter housing dairy cows.

**The Laboratory.** Fig. 1 shows a floor plan and chamber cross section of the Laboratory as used for the tests reported here.

The two chambers, or test rooms, are contained in a building approximately 60 x 40 ft outside. The outer building is an insulated rigid-frame structure covered with galvanized steel. The inner chambers are insulated as shown in Fig. 1, and have no access to the outside. A 3-ft space separates the chambers from the outer walls and ceilings except at the work rooms. Each chamber has an observation window in one side, composed of three panes of double-strength glass 25/32 in apart.

TABLE 1. AIR MOVEMENT AND LIGHT WITHIN TEST CHAMBERS

Date	Temp T	Ventilation Rate <sup>1</sup>	Group	Near Animal Surface <sup>2</sup>	Chamber Surface <sup>3</sup>	Chamber Ambient <sup>4</sup>
AIR MOVEMENT, ft./min. <sup>5</sup>						
June 17, 1949	65	360	Experimental	37	57	68
June 21, 1949	50	880	Control	49	58	46
June 24, 1949	65	920	Experimental	39	46	40
Aug. 1, 1949	95	830	Experimental	27	32	36
Aug. 5, 1949	50	970	Control	36	41	43
Aug. 9, 1949	100	830	Experimental	30	51	41
Dec. 5, 1949	5	1030	Experimental	—	—	46
Jan. 6, 1950	5	1310	Experimental	—	—	50
Jan. 27, 1950	50	750	Control	34	26	14
May 10, 1950	80	720	Holters	27	—	37
May 10, 1950	80	620	Cows	—	—	39
June 7, 1950	40	830	Holters	37	—	56
June 7, 1950	40	870	Cows	42	—	58
LIGHT, foot candles <sup>6</sup>						
June 24, 1949	65	—	Experimental	7	12	16
June 24, 1949	50	—	Control	6	—	13
Aug. 4, 1949	95	—	Experimental	6	13	17
Aug. 9, 1949	50	—	Control	6	13	16
Jan. 6, 1950	5	—	Holters	8	13	16
May 11, 1950	80	—	Holters	8	15	20

<sup>1</sup> Amount of chamber ventilation air exchange in a 30-min. dry air per cow per hour basis. Values are representative for any given test period.

<sup>2</sup> Average of six measurements taken within six inches of points where animal main body surface temperatures were measured. (University of Missouri Agricultural Experiment Station Research Bulletin 481.)

<sup>3</sup> Average for points within six inches of fifty-four chamber surface temperature stations. (Figure 1.)

<sup>4</sup> Average of fifty-four points in room where air temperatures were measured. (Figure 1.)

<sup>5</sup> Measured with an Anemometer type 6500 hot wire anemometer.

<sup>6</sup> Measured with a General Electric model 62W6575 exposure meter oriented to give the maximum reading at any one point with six 200-watt bulbs in each chamber.

Each chamber has six 4-ft-wide stalls of standard dairy barn design.

A mixture of recirculated and fresh outside air was moved through each chamber at approximately 180 cfm per cow during the tests reported. Air movements in feet per minute are shown in Table 1. These air movements are somewhat higher than are commonly found in dairy barns (1)\*, but were necessary because of the large amount of exchange air required to maintain uniform test conditions throughout the chambers. Condensation was not noted on any chamber surfaces during these tests. The carbon dioxide concentration of the chamber air did not exceed 5,000 parts per million at any time.

In general, the laboratory should be regarded as a controlled-climate barn rather

\*Numbers in parentheses refer to the appended references.

than a calorimeter. For this reason it is well-adapted to a study of basic shelter design as affected by the responses of dairy cows to various environmental variables.

**Engineering Measurement Procedures.** Under normal research procedure, the six cows in one chamber were designated as *experimental*, and the six in the other chamber were designated as *control*. If the effect of temperature was being studied, for example, the temperature was varied in the experimental chamber but held at some constant or reference level in the control chamber. This practice was not used in the spring of 1950, however, when cows were placed in one chamber and heifers in the other.

The animals used, their milk production, body weight, and testing dates are shown in Table 2. The body weights and milk production are averaged for all animals in each group, to obtain over-all comparative figures (21). The data are presumed to be representative of cows in average production weighing approximately 1000 lb. The Brahmins were included to obtain comparative data on heat tolerance of European-evolved and Indian-evolved cattle.

The chamber heat exchanges, Fig. 2, were calculated from measurements taken with recording thermometers, thermopiles and recording draft gages. The test temperatures indicated throughout this report were taken with gas-filled thermal elements placed in the return air streams as the air left the chambers. Air temperatures were also taken with thermocouples at selected points in the chambers, and surface temperatures were taken with the radiometer. The relation of these temperatures to the leaving air temperatures at different temperature levels is shown in Fig. 4. The return air temperature was used as a base for calculating the discharge air temperature from temperature difference measurements. The

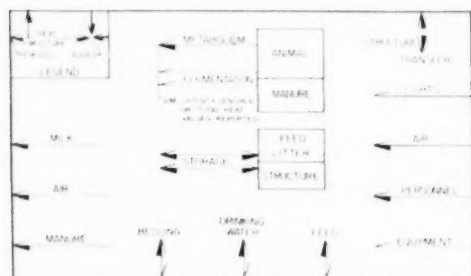


Fig. 2 Factors in heat and moisture exchange levels in the laboratory. Except for test temperatures above about 90°F, the arrows indicate the usual direction of flow. Of the factors shown, estimates were made from measurements on all factors except fermentation energies. Arrowheads pointing into space indicate addition of heat and moisture to chamber atmosphere.

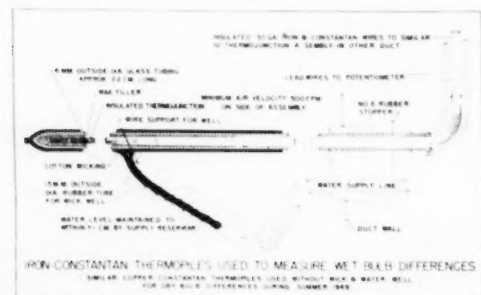


Fig. 3 Thermopile construction used in wet and dry bulb temperature difference measurements. The wet bulbs, especially in the return air, would often require cleaning twice daily and were of no use below freezing.

TABLE 2. ANIMALS USED FOR EACH TEST GROUP  
Milk production and body weights for month given to, or beginning month of testing.\*

Cow Number	Shall Number	Milk Lbs	Body Weight Lbs	Cow Number	Shall Number	Milk Lbs	Body Weight Lbs
SUMMER 1949 (May 23 to August 15, 1949)							
EXPERIMENTAL—Increasing temperature, 50° to 100° F.				CONTROL—Temperature held approx. 50° F.			
Jersey 994	1	32	770	Jersey 504	1	30	840
Jersey 212	2	34	890	Jersey 205	2	38	950
Brahman 190	3	6	760	Brahman 198	3	5	880
Brahman 108	4	10	710	Brahman 169	4	dry	710
Mulatta 109	5	36	1250	Mulatta 147	5	37	1180
Mulatta 7	6	48	1250	Mulatta 148	6	48	1010
Average		28	951	Average		27	928
WINTER 1949 (October 4, 1949, to February 1, 1950)							
EXPERIMENTAL—Decreasing temperature, 50° to 100° F.				CONTROL—Temperature held approx. 50° F.			
Jersey 957	1	24	840	Jersey 976	1	30	870
Jersey 977	2	20	920	Jersey 978	2	22	880
Brahman 190	3	dry	620	Brahman 198	3	dry	840
Brahman 208	4	dry	620	Brahman 189	4	dry	800
Mulatta 118	5	38	1200	Mulatta 132	5	41	1190
Mulatta 154	6	39	1200	Mulatta 140	6	39	1130
Average		20	973	Average		20	970
SPRING 1950 (February 6 to June 9, 1950)							
COWS—Increasing temperature, 40° to 100° F.				HEIFERS—Increasing temperature, 40° to 100° F.			
Brahman 208	1	dry	930	Brahman 2	1		450
Brown Swiss 20	2	50	1270	Brown Swiss 2	2		340
Brahman 198	3	dry	940	Brahman 3	3		410
Brown Swiss 18	4	42	1350	Brown Swiss 3	4		370
Brahman 190	5	dry	980	Brahman 1	5		500
Brown Swiss 24	6	43	1410	Brown Swiss 1	6		410
Average		24	1147	Average			407

\* For further details see University of Missouri Agricultural Experiment Station Research Bulletin 460 and 471.

differences for both wet and dry-bulb readings were measured by thermopiles as shown in Fig. 3. The return-air recorder-controller wet bulb was used as a reference base for wet-bulb temperatures. Beginning in 1950 the dry-bulb thermopiles were made of 24-gauge copper-constantan junctions with each junction plus at least one inch of lead wire exposed to the air stream. The wet bulbs were replaced with electrolytic hygrometers in order to secure continuous records on temperatures at or below freezing.

Air volume was measured by a Hays recording draft gage of the slack-diaphragm type having a range of 0.00 to 0.20 in. of water. The draft gage was connected to industrial-type combined reverse pitot tubes placed in the center of the 16-in.-diameter discharge air ducts. The discharge ducts were cross-sectioned for velocity by ASHVE methods (3) using a factory-calibrated Alnor "velometer", having a combined reverse pitot tube to get center factor and instrument factor corrections. The velometer has a 0 to 2000-fpm scale.

The draft-gage readings were converted to a pounds of dry air per animal per hour basis. A modification of the kinetic energy formula (4) for standard pitot tubes in air at constant

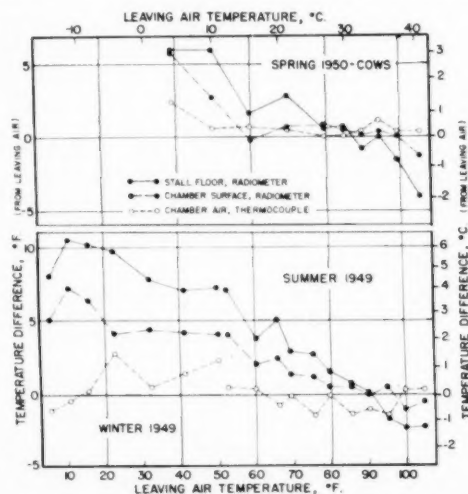


Fig. 4 Evaluation of the return (or chamber-leaving) air temperature as a measure of the environmental conditions. Surface and air temperatures were taken as described in Missouri Agricultural Experiment Station Research Bulletin 181, at the various locations indicated in Fig. 1.

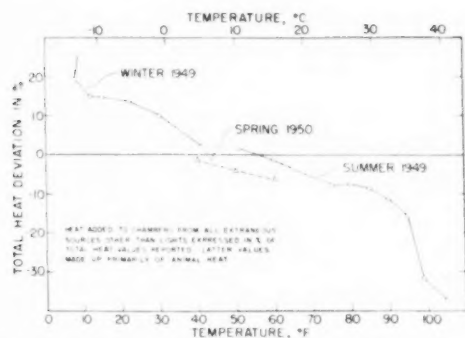


Fig. 5 Sum of milk, drinking water, personnel, equipment, structural storage and transfer, feed, bedding, and manure heat-exchange estimates expressed in per cent of the total heat values reported. All total heat values are found by subtracting from the heat added to the moist ventilating air the extraneous factors just noted, as well as the heat input of the lamps. Disregarding experimental errors, this total heat value corresponds to the sum of fermentation energies and animal metabolism (Fig. 2). These per cent deviations are based on the average total heat at each temperature level.

pressure was used for the conversion. The relationship used was

$$A = C \frac{D}{v(1+u)}$$

where  $A$  is the pounds of dry air exchanged on a per animal per hour basis for a chamber;  $C$  is a proportionality constant made up from the following factors: (a) instrument and pitot tube correction factors mentioned, (b) cross-sectional duct area, (c) average station barometric pressure of 29.2 in Hg, (d)

Hays combined reverse pitot tube constant, 957.2, (e) time, and (f) number of animals;  $D$  is the draft gage reading of velocity or differential pressure in inches of water column,  $v$  is the indicated volume of moist air per pound of dry air at discharge-air temperature and humidity at 29.9 in Hg, and  $u$  is the amount of water per pound of dry air in discharge duct or point of measurement.

The constant,  $C$ , was calculated whenever calibration was necessary due to wide changes in test conditions. Values of  $D$ ,  $v$ , and  $u$  were taken from the average readings for each day. The  $A$  values as found were then multiplied by the enthalpy differences and moisture-ratio differences to obtain total heat and moisture picked up in each chamber on a per animal basis.

Floor heat losses were estimated by measuring the temperature gradient between the 1/2-in conduits buried in the floor as shown in Fig. 1. Temperature differences were measured by copper-constantan thermopiles with junctions spaced 2 ft apart in the two pairs of conduits under the stalls; the junctions were spaced 12 ft apart in the other three pairs of conduits where temperatures were more uniform. The coefficient of conductance for the concrete was assumed to be 12.5 Btu per sq ft per hr per inch in thickness per degree Fahrenheit.

The heat flow through the walls and ceiling was estimated by measuring the temperature differences between the inner and outer surfaces with ten pairs of copper-constantan thermopiles, each pair representing an equal area on the wall or ceiling. The  $U$  value, or over-all coefficient of conductance, was estimated to be 0.08 Btu per sq ft per hr for the wall and ceiling sections.

Heat input from the lights was estimated by spot-checking with a watt-hour meter. Similar measurements were made on laboratory electrical equipment used in the chambers. Heat exchanges due to milk, bedding and manure were estimated from periodic measurement of quantities and temperatures of drinking water, feed and bedding entering the chamber, and milk and manure taken from the chamber. Heat storage within the walls, floors, and chamber contents was calculated to be about 30 Btu per hr per deg F change per day per animal averaged over a 24-hr period. For example, if the chamber temperature was changed at a uniform rate of 5 F in 24 hr, the storage factor would then be 150 Btu per animal per hour. No attempt was made with present measurements to estimate storage for hour to hour temperature changes; therefore, all values of storage used on hourly data are the same as those estimated for the entire day.

The presence of laboratory personnel in the chambers caused an extra heat input. This input was estimated by using 760 Btu per man-hour (5) for all temperatures, with evaporative heat losses ranging from 12 per cent of this total at 50 F to about 110 per cent of the total at 95 F.

Errors due to door leakage varied up to 3 per cent of the total heat with this factor, giving a higher net value because the chambers were always under a slight pressure.

Secondary sources of heat and moisture, other than lights, are briefly summarized in Fig. 5. The values are totaled as a per cent of the total heat values reported. Values at the extreme temperatures are somewhat erratic because of the short time available to stabilize chamber conditions. At low temperatures the major contributions to the deviations were floor conductivity, water heaters and electrical equipment. At high temperatures the deviations were affected largely by enthalpy changes in water consumed, floor conduction, personnel, and time lags.

The moisture evaporated from the stall surfaces was estimated in 1951 for small and large cows. Vapor-pressure gradients were measured by electrolytic hygrometers, and the values were substituted in an evaporation formula (9).

**Discussion of Data.** Fig. 6 shows a summary of heat exchanges found for the experimental group of 1949. Two important facts are brought out graphically in Fig. 6: (a) total heat production increases as barn temperatures decrease, and (b) the ratio of latent to total heat production decreases with decreasing temperature. In general, this ratio is higher for the

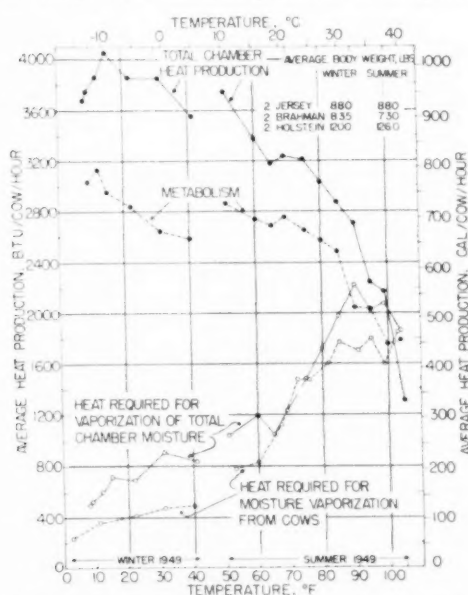


Fig. 6 Total and latent-heat exchanges for the 1949 tests. These values are made up primarily of fermentation energies from animal rumen and manure, and animal metabolism. Heat from lights and extraneous or secondary factors in Fig. 5 are not included.

chamber than for the animals themselves, as evidenced by the animal vaporization curve. This is because bedding, gutter and manger surfaces receive energy from the animal which in turn is used to vaporize water. Animal heat travels to these surfaces mainly by conduction while lying down, radiation while standing, and by body heat loss through urine and feces. Since fermentation energies were not measured or estimated, their contributions to heat and moisture production are not known.

In Fig. 6 there is a significant difference between total chamber heat production and metabolism as measured by the mask open-circuit apparatus. This difference arises principally from (a) the fermentation energy mentioned which is not measured by the metabolism apparatus (6), (b) metabolic measurements were taken at a certain time each day, whereas ventilation data are from continuous records, and (c) the chamber air leakage which was previously mentioned.

The initial milk production levels for the 1949 tests shown in Table 2 indicate high values for the summer group. These animals, therefore, had the highest total heat production. This fact brings out the importance of knowing herd milk production, as well as animal size and maintenance requirements, in order to estimate ventilation loads. The relationships between total digestible nutrients and metabolic levels of the test animals are discussed in detail in publications of the Missouri environmental physiology series (7).

Measurements made on the winter 1949 experimental group at 50°F are not reported because of equipment difficulties.

Fig. 7 is presented as a summary of the heat and moisture relationships for all groups as correlated with ambient temperature. The ratio  $q$  represents total Btu of heat per pound of moisture removed from the chamber. This ratio is similar to that used for graphical analysis on the 1951 ASHVE psychrometric chart. The curvilinear regression line in the lower segment of Fig. 7 can be used to solve practical ventilation problems where only an estimate of either the total heat exchange or the moisture exchange is available.

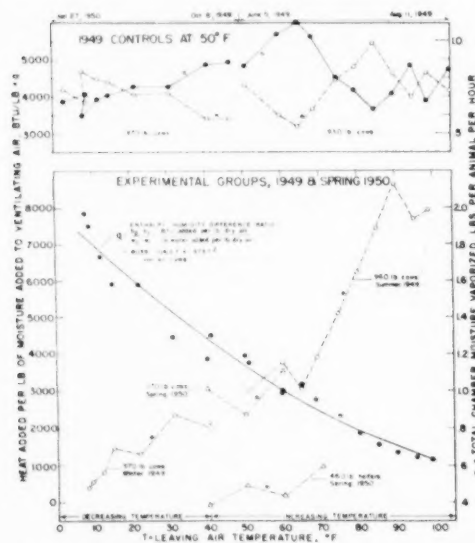


Fig. 7 Summary of heat and moisture relationships for all groups reported. Values for the heat and moisture production of the control group at 50°F during the summer 1949 are taken from unpublished data presented at the winter meeting of the American Society of Agricultural Engineers in Chicago, Ill., in December, 1949, by H. J. Thompson and R. E. Stewart, entitled "Effect of Temperature Upon Heat and Moisture Production in Dairy Barns."

No attempt was made to fit a smooth curve to the moisture data of Fig. 7 due to the rather wide variations. Fig. 6 gives comparisons of these data with the insensible water losses of the 1949 group (8). Placing the measurements on a 1000-lb body-weight basis would give moisture values similar to those shown. Even the cow and heifer data are fairly comparable on a 1000-lb body-weight basis. It then follows that, secondary factors remaining constant, the moisture production of a 4-ft dairy stall varies directly with animal size.

Consider the upper segment of Fig. 7. As expected with a relatively constant source of total heat, the ratio  $q$  should rise with a decrease in  $n$ . The correlation between  $q$  and  $n$  is surprisingly uniform. This suggests that the heat transferred to the air from the urine, feces and bedding takes place primarily in the latent state. Therefore, cleaning up moist bedding and feces may be an important step in reducing ventilation moisture loads.

The variations shown in the upper segment of Fig. 7 could also be caused by errors in wet-bulb temperature-difference measurements on the air exchange. Changes in heat production under a constant environment can also be caused by changes in level of milk production and other factors. It is assumed that the seasonal change in length of hair displayed by the cows used in these experiments followed the natural cycle by shortening with increasing temperature and lengthening with decreasing temperature.

The values of Fig. 7 are based on heat and moisture production from the primary sources, animal metabolism and fermentation heat from bedding and manure. They may give higher or lower values than exchanges which have not accounted for secondary sources, such as lights, building transfer, and temperature differences on materials taken in and out of the barn. In practical application of these data it is necessary to consider the effects of secondary sources.

(Continued on page 206)

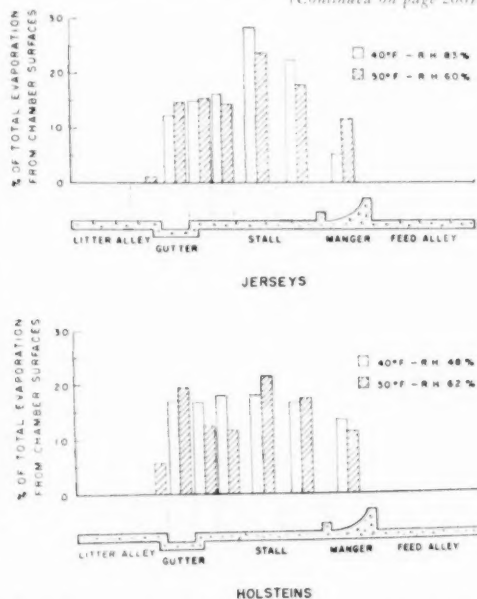


Fig. 8 Percentage of total chamber surface vaporization from the litter alley, gutter, rear one-half of back one-third of stall platform, front one-half of back one-third of stall platform, middle one-third of stall platform, front one-third of stall platform and manger, of stalls 4 ft wide (from Fig. 12 of reference 9). These values must be considered tentative as they are based on a limited number of observations for only one set of tests.

# Differential Thermostats for Agricultural Applications

By F. D. Yung and L. H. Soderholm

MEMBER ASAE

**P**ROBLEMS of temperature control in western Nebraska potato storages serve well to illustrate the inadequacies of the common thermostat in some agricultural applications. At harvest time potatoes are placed in storage bins, allowed to cure at 55 to 70 F for ten days to two weeks, and then cooled as quickly as possible to 40 F and later to 32 F. A practical method of cooling the potatoes is to circulate cool air through the storages (1)\* or around shell-cooled bins (2) within the storage structure whenever the outside air temperature is lower than the temperature inside the storage. A common thermostat is not suitable for controlling the ventilating equipment under such conditions because there is a progressive decline in the temperature level (in the potato storage) at which the action of the thermostat is desired. It can, however, be used to fix minimum or maximum temperature limits.

A differential thermostat provides the type of control that is needed in a potato storage, or in a similar application, be-

cause it is actuated by temperature differences. It will, for example, start ventilating equipment whenever outdoor air temperature is lower than that of the air within the storage and will stop the equipment when the favorable temperature differences no longer exist. Moreover, it makes possible the cooling of the stored product to below average outdoor temperature by making use of the cold end of the outdoor temperature range.

Two mechanically operated differential thermostats were developed prior to the electronic unit. One of them used 3 in round thermostatic wafers as the temperature-sensing elements. These wafers did not have the desired uniform expansion characteristics through the temperature range that was needed. The second thermostat (5), Fig. 1, has bimetallic temperature sensing elements which respond uniformly to temperature changes throughout the required range of 32 to 100 F. The bimetal differential thermostat has been in service on one of the University of Nebraska farms for eight years. Both mechanical units are limited to installations where the indoor and outdoor temperature-sensing elements can be less than 5 ft apart.

Experience with the mechanical differential thermostats established several important functional and design requirements. These include flexibility of installation, ruggedness of construction, good sensitivity, and moderate cost. The electronic differential thermostat embodies these desired features.

The two temperature-sensing elements of the electronic differential thermostat depend on the electrical characteristics of "thermistors". The thermistors are commercially produced thermal resistors which undergo a relatively large change in resistance with only a small change in temperature, Fig. 2.

The electrical circuit consists basically of a vacuum tube in which the grid bias is controlled by two thermistors, each of which is in an arm of a bridge circuit (Fig. 3). The plate current, which varies with grid bias, actuates a sensitive relay which in turn controls a contactor for an electric motor. A d-c voltage is applied to the bridge from an isolating transformer and selenium rectifier. The magnitude of

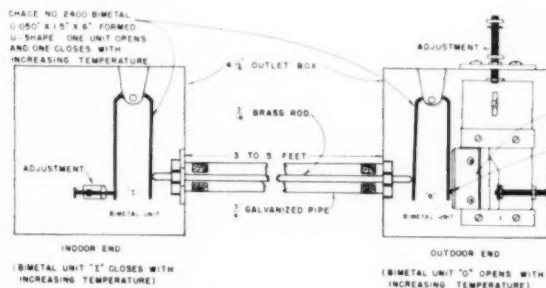


Fig. 1 Mechanically operated differential thermostat having bimetallic temperature-sensing elements

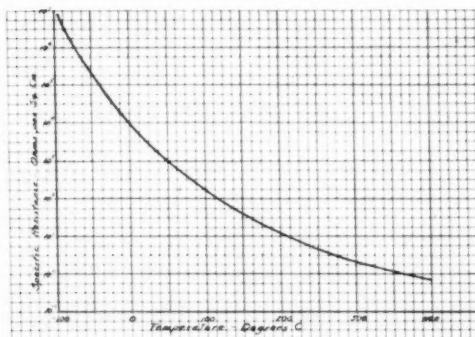


Fig. 2 This chart shows how thermal resistors undergo a relatively large change in resistance with only a small change in temperature, in the electronic differential thermostat

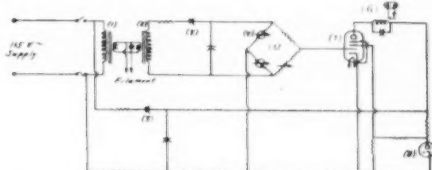


Fig. 3 Circuit diagram of the electronic differential thermostat: 1, filament transformer; 2, isolation transformer; 3, selenium rectifier; 4, thermistor; 5, bridge circuit; 6, relay; 7, control tube; 8, voltage-regulator tube

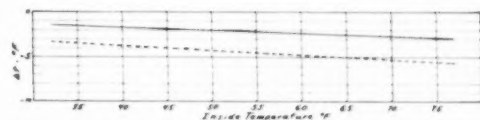


Fig. 4 Performance curve of electronic differential thermostat.  $\Delta T$  is the differential between inside temperature ( $T_i$ ) and outside temperature ( $T_o$ ). The solid line shows  $\Delta T$  when circuit to ventilating equipment opens, and the broken line shows  $\Delta T$  when circuit closes. The zero line represents the condition when inside and outside temperatures are equal

the bias voltage applied between the grid and cathode is determined by the resistance of the bridge arms. The absolute value of voltage depends on the relative resistances of the thermistors which are in turn dependent on temperatures. If the outdoor temperature falls below the indoor temperature, the resistance of the outside thermistor is relatively increased, the grid bias is lowered, the plate current is increased, and the relay closes. As the outdoor temperature rises, the reverse actions take place. A variable resistance adjusts the initial bias so that the relay will close when the outside thermistor is at a slightly lower temperature than the inside thermistor. The change in reluctance of the magnetic path in the armature of the relay is utilized to produce snap action in the relay and hold it firmly closed.

The operating characteristics of the electronic differential thermostat are shown in Fig. 4. The dotted lower line represents the differentials between thermistor temperatures which will close the circuit. These differentials may be controlled by adjustment of the variable resistor in the bridge circuit. The solid upper line represents the differentials in thermistor temperatures which will open the circuit. This line is displaced from the line representing the closing temperatures because of the change of reluctance in the magnetic circuit of the relay armature. The difference between temperature differentials on which the thermostat operates is nearly linear over the range of 35 to 75 F, having a nominal value of approximately 2 F and increasing slightly at the higher temperatures. The exact characteristics can be varied slightly by selection of thermistor pairs. The difference between temperature differentials may be varied by changing the adjustment of the air gap of the relay armature.

An important feature of this thermostat is that in the event of control-tube failure the supply circuit to the ventilating equipment is left open. This stops the equipment and prevents the movement of warmer air into the storage. Under these conditions, the most serious result would be loss of cooling time until the tube is replaced. Power consumption of the thermostat is approximately 16 w.

Fig. 5 shows the electronic differential thermostat with the top of the central control unit removed. The glass jars contain the thermistors and afford them some degree of mechanical protection. The jars also prevent unnecessary operation of the thermostat due to momentary fluctuations of air temperature.

#### SUMMARY

Several functional and design requirements of differential thermostats were established during the development and use of two mechanical types. One very important requirement is flexibility of installation. Other desirable features include ruggedness of construction, good sensitivity, and moderate cost. The electronic differential thermostat embodies all of these features and is especially well adapted to installations under a wide range of conditions. Its outstanding versatility makes it potentially suitable for other applications in fields such as air conditioning, grain and hay drying, and industrial processing.

#### REFERENCES

1. Wenner, H. O. Potato Storage Structures for Nebraska, Nebr. Agricultural Experiment Station, Horticulture Progress Report No. 7 (July, 1945).
2. Wenner, H. O. Commercial Potato Production in Nebraska, Nebr. Agricultural Experiment Station Bulletin No. 548 (June, 1947).
3. Young, E. D. A Bimetal Differential Thermostat, Nebr. Agricultural Experiment Station, Agricultural Engineering Progress Report No. 10 (January, 1947).

## Heat and Moisture Exchanges in Dairy Barns

(Continued from page 204)

A preliminary study of evaporation from the stall, manger and gutter surfaces was done at a later date than the previously reported studies (9). The data indicate that at air temperatures from 40 to 50 F, the evaporation from stall surfaces ranged from 58 to 65 per cent of the total moisture load. Fig. 8 shows a percentage partition of the surface vaporization

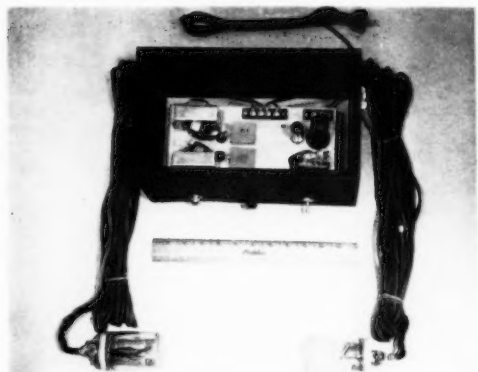


Fig. 5. Electronic differential thermostat with the top of the central control unit removed.

among arbitrary segments of the stalls (9). Fig. 8 also indicates that the gutter contributes a smaller portion of the evaporated moisture than has before been considered possible. Absolute amounts vaporized from the surfaces averaged from about 9 to 15 lb per cow per day, with the larger amounts originating at stalls occupied by larger cows. Continued study of surface evaporation as affected by type of bedding and other variables is a part of the laboratory program.

Complete and detailed tabular data related to the work reported here will appear in future publications of the Missouri Agricultural Experiment Station.

#### SUMMARY

Data are presented which indicate that total heat exchange on a dairy barn basis is higher than that given by metabolism measurement. A 20 per cent increase in heat production occurs when temperature falls from 80 to 10 F. Moisture measurements indicate surprisingly large amounts of water vaporized from chamber surfaces. Near 100 F the total and latent heat production are nearly equal. Dairy barns dissipate a higher per cent of their normal heat production by vaporization than the animals within.

Ratios of total heat production to moisture production for an ambient temperature range of 8 to 100 F are presented for use in designing ventilation systems for dairy barns. These ratios can be of use where either the total heat production or the moisture production are available to the designer.

#### REFERENCES

1. American Society of Heating and Ventilating Engineers Guide (ASHVE Guide), 1951, p. 651, with reference to air movement on man.
2. See University of Missouri Agricultural Experiment Station Research Bulletins 460 and 471 for detailed milk production records.
3. ASHVE Guide, 1951, p. 1028.
4. ASHVE Guide, 1951, p. 1029, gives  $V' = 1096.5 D/P$  where  $V'$  is air velocity in feet per second,  $D$  is density of moist air in pounds per cubic foot.
5. ASHVE Guide, 1948, p. 209, Table 4, estimate for an average man walking 2 mph, and Curve E, Fig. 7.
6. Washburn, I. F., and Brody, S. Methane, Hydrogen, and Carbon Dioxide Production in the Digestive Tract of Ruminants. Mo. Agr. Exp. Sta. Res. Bul. 265, 1937, and 293, 1940.
7. Kibler, H. H., et al. Effects of Temperature, 50 to 105 F and 50 to 9 F, on Heat Production and Cardiorespiratory Activities in Brahman, Jersey, and Holstein Cows. Mo. Agr. Exp. Sta. Res. Bul. 464, 1950.
8. Thompson, H. J., et al. Influence of Temperature on Insensible Weight Loss and Moisture Vaporization in Brahman, Brown Swiss, Holstein, and Jersey Cattle. Mo. Agr. Exp. Sta. Res. Bul. 479, 1951.
9. Baxter, Denver Olen. An Investigation of Moisture Evaporation from Floor Surfaces in a Dairy Stable at Temperatures of 10 and 50 F. Unpublished M.S. thesis, University of Missouri, August, 1951.

# The Evolution of Materials for Farm Tractors

By Stanley Madill

President ASAE, 1951-52

**S**ELECTION, treatment and finishing of materials and the development of new materials have made a major contribution to the advancement of farm mechanization. From the processing of the raw materials down to the finished product, the chemists, metallurgists, material engineers and processing specialists are continually working toward securing greater value in the end product. The design and test engineers are best known to the men in the field; however, they rely very heavily on the former for information and help in many of their problems. If the proper material is not available and the job represents volume enough to pay to develop a new material, steps are usually taken to do so.

Wars accelerate progress in improving materials and developing new uses for them. During a war the demand for materials is usually greater than the supply and many critical material shortages develop. Meeting the shortages with substitute materials usually contributes toward progress, in that necessity forces us to make the best use of materials available. Today's high production rate is depleting our raw materials to the extent that there is a shortage in the supply of many of the elements used in alloy steel, bearings and corrosion-resistant materials. To a large extent in structural members, we have been able to develop substitutes for many of these materials, and through the substitutes we often come up with a better and more economical part. If we had to rely on the alloy materials used in steel production 15 years ago, our production of alloy steel would be limited to a small percentage of what it is today.

The farm tractor of today has little resemblance to the early traction engines which were heavy, slow and subject to a high rate of wear. Their construction was principally with mild steel and soft gray iron. Many wearing parts were unprotected from abrasives and force-feed lubrication was limited to a few of the bearings. The advantages of enclosing the gears and running them in oil or grease was recognized early. Enclosing the gears required making smaller, higher stressed parts and operating them at higher speeds. To accomplish this required heat-treated parts, greater accuracy in manufacturing, smoother finishes and much better lubrication. Roller and ball bearings replaced plain bearings in many places and improved lubricants were developed along with better means of sealing the oil in and the dirt out.

The advancement made in the alloying of steels is a dramatic story in itself. Prior to World War II the nickel chromium steels (3100 series) were commonly used for high-grade gears and heat-treated parts. The nickel supply became extremely short and the 8600 series of steels were developed which reduced the amount of scarce alloying elements in the steel by one-half and still maintained the same performance characteristics. The hardening ability of 8600 series runs more uniform and permits securing a larger portion of the alloying materials from scrap. Now we are faced with an insufficient supply of alloys to produce the required amount of 8600 series steel. Again we are getting ready to meet this further curtailment of alloys by the use of boron-

treated steels. In most cases the addition of a very small amount of boron to a steel of low alloy content (derived from an extremely plentiful material commonly known as borax) produces a steel that can be heat-treated and will produce a satisfactory product. The residual alloy in the alloy steel scrap is usually sufficient for the boron steels. Our metallurgists and materials engineers are in the midst of an extensive development program learning to use and control the boron-treated steels. Our experience to date indicates that they can be made to produce a product equal to the 8600 series. Table 1 shows amounts of principal alloys found in some comparable steels.

Advancement in heat-treating processes has contributed materially to reducing the requirement for alloy steel. Induction hardening is in common use in many of the factories today and permits local hardening where required, permits using a carbon steel in place of an alloy steel, and in many applications simplifies the handling and speeds up the manufacturing processes. The parts receive individual treatment in machines that are electronically controlled which results in a more uniform product than can be obtained in the batch-type furnace or where the part is fully heated. The results have shown less variation in hardness and dimensions where induction hardening has replaced the furnace and dip-tank method. There is a saving in heat and also a saving in material handling as the induction hardening setup can be placed in the processing line so that the material passes directly from the machining to the hardening equipment. Often there can be a saving in finished machining time as the part need not be hardened except in the areas of greatest stress or wear. Induction-hardened final drive gears are now used in most all of the John Deere tractors. They have been found to be stronger, more accurate and easier to handle than the previous carburized alloy gears. 1050 carbon steel is used with no other treatment than induction hardening.

Carbonitriding of carbon steel parts is also being used to reduce alloy steel requirements. The concentration of carbon and nitrogen in the surface produces a high surface hardness with an oil quench. Oil quenching produces less distortion than the more drastic quenches. We are having very good results with carbonitriding on parts with light sections.

Advancement in manufacturing processes has also been a very important factor in adapting economical materials to a given job. Improvements in tool steels permit the machining of parts that were considered too hard to machine a few years ago. Higher hardness aids in grinding to closer tolerances and in producing finer finishes. Generally speaking, strength and resistance to wear are proportional to the hardness of the steel. By being able to build machines out of materials of higher hardness permits them to be lighter, stronger and more durable.

Surface-finish standards and the specifying of the degree of smoothness required have come into general use the last 10 years. The establishment of a method of measuring and specifying finish has made it possible for the designer to specify on the drawing the finish desired. Better finishes have reduced the danger of early failure of

(Continued on page 212)

COMPARATIVE TABLE ON ALLOY STEELS

Type of steel	SAE No.	C	Mn	Ni	Cr	Mo	B	Critical alloy, per cent
Nickel	2317	0.15-0.20	0.40-0.60	8.25-8.75				5.50
Nickel Chromium	3120	0.17-0.22	0.60-0.80	1.10-1.40	0.55-0.75			1.90
Molybdenum	4017	0.15-0.20	0.70-0.90			0.20-0.30		
Manganese	1420	0.18-0.23	1.60-1.90					
Nickel Chromium Molybdenum	8620	0.18-0.23	0.70-0.90	0.40-0.70	0.40-0.60	0.15-0.25		1.25
Boron	80B20	0.17-0.23	0.60-0.90	0.20-0.40	0.15-0.35	0.08-0.15	0.0005	65

Paper presented at a meeting of Pacific Northwest Section of the American Society of Agricultural Engineers at Moscow, Ida., October, 1951

The author, STANLEY MADILL, executive engineer, John Deere Waterloo Tractor Works of Deere Manufacturing Co., Waterloo, Ia.

## Surface Drainage of Tight Soils in the Midwest

By Keith H. Beauchamp

MEMBER ASAE

**S**URFACE drainage of the individual field has probably been the most neglected of all the different phases of agricultural drainage. The engineer as well as the farmer has been responsible for this neglect. Very few publications have been written; research has been slow. The engineer has been more interested in larger outlet ditches, tile systems, pumping and control drainage, leaving the farmer to work out some way to get the excess surface water to the outlets.

You have all ridden along the highways in drainage country after a rain, and have noticed small ponds of water standing only a few feet from the road ditch, drainage ditch or natural watercourse. A small amount of labor with a shovel or plow would have drained this water away. The farmer, in many cases, has tried to solve his surface-drainage problem, but his approach is generally piecemeal and not according to an over all analysis and plan. Bedding has been practiced in some localities for many years. Quite often the beds are located in the wrong direction or the number and location of collection ditches is not adequate for most effective drainage.

The control of surface water is one of the keys to proper moisture relationship for plant growth. The problem of control varies between permeable soils on hilly land and tight soils on flat land.

On hilly land with permeable soils conservation of moisture is the goal. This is accomplished by contouring, strip cropping, terracing and growing grass.

Water control on gently sloping to flat land with permeable soils is by surface channels and tile drainage. The highest degree of drainage for these soils is nearly always obtained by a combination of open and closed drains. To make more effective use of a tile system, the surface water should be removed rapidly from the field. As soon as the surface water has been removed the tile can then start its job of removing the excess soil water. Too often the surface drainage system is not given the investigation and planning that goes into the development of a tile plan. The two systems should be worked out together, and any final drainage plan should provide in detail for both the surface and subsurface drainage.

Adequate drainage of gently sloping to flat, so-called tight soils can best be accomplished by using a complete surface drainage system. In general, these soils have a few inches of moderately permeable soil over a subsoil that has slow to very slow permeability. Tile can and is being used on some of our tight soils where the moderately permeable soil is deep enough to provide a sufficient drainable area for the tile. However, for adequate drainage the tile spacing must be so close because of the shallow depth of permeable soil that tiling is seldom economical for general field crops.

In the eight midwestern states of Minnesota, Wisconsin, Michigan, Ohio, Indiana, Illinois, Iowa and Missouri there are approximately 50,000,000 acres of tight soils on which adequate surface drainage is needed. Fig. 1 shows the approximate general areas of tight soils in these midwestern states. In each of these areas there generally can be found some small areas of more permeable soils. Also, outside of the areas shown there are many small areas of tight soils.

The largest area is the claypan soils of Missouri and southern Iowa, and in the southern parts of Illinois, Indiana and Ohio. These soils have from 9 to 20 in of permeable soil over a very slowly permeable or impervious claypan. The slopes vary from 0 to 5 per cent with most of the area predominantly level. In general, tiling is not economical or successful. There are scattered small areas where the claypan is

far enough below the ground surface to permit fairly successful tiling. The claypan area in western Missouri is more sloping with the claypan generally farther from the surface. This area does not present as difficult a drainage problem as is encountered in the other claypan areas.

The Alameda-Spencer soils in central Wisconsin make up another large poorly drained tight soil area. These soils generally have a thin topsoil over a silt pan. Internal drainage is poor from the plow sole downward. Tile is not effective. The slopes vary from 0 to 1 per cent. The area contains more sloping land than level. The many shallow depressions and pockets add to the surface drainage problem.

The Mahoning soils in northeastern Ohio are similar to the Alameda soils of Wisconsin. They too have a thin topsoil over a so-called silt pan and tiling is generally not effective or economical. The slopes vary from 0 to 6 per cent and there are many small depressions and pockets.

The heavy clays of the Red River Valley in Minnesota are flat and drain slowly. The area is covered with many ponding depressions varying from large to quite small. Very little tile drainage has been used in the past. The two areas east of the river are spotted with knolls of sandy material over clay base.

On the Canadian border in Minnesota there is a large area of very tight plastic clay. These soils were formed by old Lake Agassiz and are similar to the Red River clays, but of lower fertility. The slopes in this area average from 2 to 4 per cent.

In northern Illinois there are the Clarence and Swygert plastic tills. Internal drainage of these soils is very slow. Slopes vary from 0 to 4 per cent. The studies of Kidder and Lytle\* indicate that the benefits from tile drainage in most of

\*J. H. Kidder and W. E. Lytle. Drainage Investigations in the Plastic Till Soils of Northeastern Illinois. AGRICULTURAL ENGINEERING, vol. 50, pp. 584-586, 589, August, 1949.



Fig. 1. Approximate general areas of tight soils in the Midwest area of the United States.

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1951, as a contribution of the Soil and Water Division.

The author, KEITH H. BEAUCHAMP, head, drainage and irrigation section, regional engineering division, Soil Conservation Service, U.S. Department of Agriculture (Milwaukee, Wis.).

the plastic tills are very limited.

The Sharkey clays of southeastern Missouri also present surface drainage problems. Internal drainage of these soils is very slow. Tile is not effective. The land is flat with slight depressions.

The Paulding-Nappanee soils area of northeastern Indiana and northwestern Ohio are heavy, very tight soils with permeability decreasing with depth. They are level to nearly level with many small depressions. They can be and are being tile-drained with tile spaced 2 to 3 rods apart. A system of adequate surface drainage is required, with or without tile, for effective drainage. Within this area shown on the map there are many scattered areas of better-drained soils.

The Red Plastic clay area shown in northern Wisconsin and Michigan has a subsoil of heavy red clay with slope varying from level to gently sloping. Depression areas are common. The area around Lake Winnebago in Wisconsin is a red silty clay loam with a tight subsoil.

Surface drainage is the major field drainage practice on most of our river bottom soils. The narrow strip along the Missouri River in Missouri and Iowa is composed of what is commonly called heavy gumbo and spotted with sandy areas. The land is nearly level with many depressions and swales. In the Mississippi and Illinois River bottoms there are large areas of heavy gumbo soils with other areas of better drained soils. The land here is also level and has depressions and swales. Drainage outlets for most of this area are provided by pumping.

The purpose of a surface drainage system is to rid the land quickly of its excess water, thereby preventing the land from becoming too wet and soggy and allowing the wind and sun to start their job of drying the soil as soon as possible after a rain. To accomplish this the surface drainage system must be so planned and installed that surface water will not be allowed to collect and stand in any area of the field. The key to surface drainage is to keep the runoff water moving — moving off the field as rapidly as possible without causing erosion of the land surface or in the ditches.

There are essentially five types of field surface drainage systems used in the Midwest. Occasionally it is necessary to

combine two or more of these systems in order to secure the desired results. These five systems may be spoken of as the (1) bedding system, (2) random ditch system, (3) cross slope ditch system or drainage-type terraces, (4) parallel ditch system, and (5) field ditch system for water table control and surface water removal. The selection of the system to use on a given field depends upon the topography of the land, the soil type, possibly crops to be grown, and the farmer's desires.

#### BEDDING SYSTEM

Bedding has probably been used more in Ohio as a surface drainage practice than in any of the other midwestern states. Ross Milner, county agricultural agent, Ashtabula County, Ohio, has devoted much time to the study and development of criteria for bedding design and layout. He has published his recommendations in Bulletin No. 299 of the Agricultural Extension Service, Ohio State University.

The "bedding system" (Fig. 2) of surface drainage is generally used on fields that are practically flat, slopes from 0 to 1.5 per cent, where the soils are slowly permeable and where tile drainage is not economically feasible. The system is designed, constructed and maintained so that excess surface water drains laterally from beds, similar to plow lands, into deadfurrows, thence into the collection ditches and finally into an outlet ditch. The beds should be laid out with the deadfurrow running in the direction of greatest slope. The collection ditches, which intercept the water from the deadfurrows, are laid out in the direction of lesser slope because they can be graded toward the outlet by construction methods.

Width of beds is governed by the following conditions:

- 1 Kind of crops to be grown. Some permanent pasture or hay crops do not require as narrow beds as do general rotation crops.
- 2 Slope of the field. Flatter fields require narrower beds.
- 3 Drainage characteristics of the soil. Soils with low infiltration and poor permeability require narrow bedding.
- 4 Adaptability to farming operations. It is usually unprofitable to grow row crops in deadfurrows. Thus, bed widths should be adjusted so that the rows will fit the beds without

#### SURFACE DRAINAGE BEDDING SYSTEM

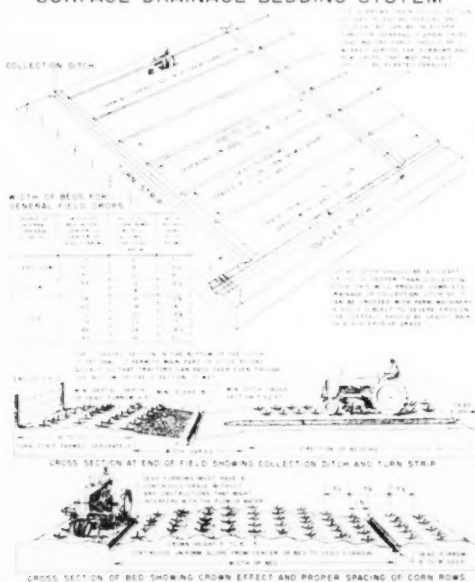


Fig. 2

#### RANDOM DITCH SYSTEM OF SURFACE DRAINAGE

REMOVE MAJOR DEPRESSIONS BY LAND SMOOTHING WITH LAND PLANE OR LEVELER. SMOOTH AREA SO LAND WILL DRAIN TO THE LARGE DEPRESSIONS OR RANDOM DITCHES.

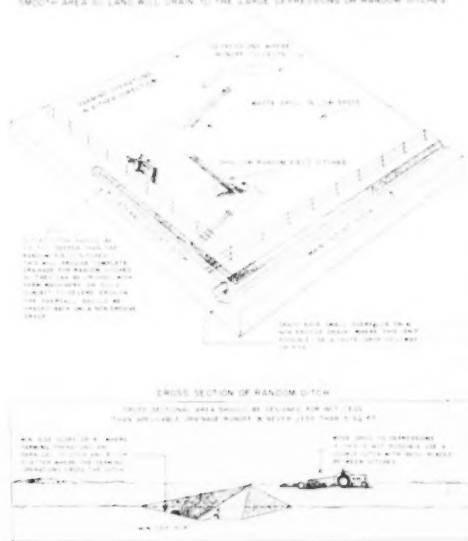


Fig. 3

unnecessary waste of ground along deadfurrows or crowding of rows too close to the deadfurrows. The width should be a multiple of one through or one round with the plow, planter and cultivator.

For the bedding system to function properly all deadfurrows must have a continuous grade with no obstructions or low points that would interfere with the complete drainage of the furrow. Where depressions obstruct the flow, this condition should be remedied by tilling, cutting the deadfurrow deeper, or tapping the depression with a collection ditch.

The collection ditches are a very important part of any bedding system as they carry the surplus water away from the bedding furrows. These should be spaced at regular intervals across the slope of the field depending upon the amount of slope and the permeability of the soil. Where the land is nearly flat and the permeability of the soil very slow, a spacing of about 500 ft is generally required. This can be varied up to 1,000 ft for more sloping soil of fair permeability. Where collection ditches are placed at the end of the field, the ditch should be placed about 16 to 20 ft from the end to provide a turn strip so that drainage from the rows into the ditch will not be obstructed.

Some general recommendations on bed width and layout and construction details are given in Fig. 2.

#### RANDOM DITCH SYSTEM

The "random ditch system" (Fig. 3) is adapted to depression-type topography having wet pockets or depressions too deep or large to fill by land smoothing. The random surface ditch should meander from one low spot or depression to another so that the water flows toward the lateral outlet ditch.

The random ditch must be of sufficient size and depth to drain off the impounded water rapidly and completely. Spoil from these ditches should be placed in the minor depressions that will not be drained by ditches.

To secure the highest degree of drainage the entire field should be smoothed or graded to fill all of the minor depressions and thus allow the surface water to flow to the ditched-out depressions or directly to the ditch. On flat, very slowly permeable soils it may be necessary to combine this system with the bedding system to do an adequate job of surface drainage. On tileable land having large and deep depressions this system should be used in conjunction with the tile drainage.

The random ditch will usually be located in cultivated fields. Where not too deep, these ditches should be constructed so that they can be crossed with farm machinery. General recommendations are shown in Fig. 3.

#### CROSS SLOPE DITCH SYSTEM

The "cross slope ditch system" (drainage-type terrace) (Fig. 4) resembles terracing in that the drainage ditches are constructed around the slope on a uniform grade according to the lay of the land. Much of the development work on this type of surface drainage has been and is being done by A. J. Wojta of the University of Wisconsin. A paper by Mr. Wojta, entitled "The Development and Study of the Channel Type Terrace", was published in *AGRICULTURAL ENGINEERING* for May, 1950.

This method of surface drainage is adapted to sloping, wet fields of 1 per cent slope or less, where internal drainage is poor from the plow sole downward and where many shallow depressions hold water after rains. The nature of the soil is such that the surface water which collects in these low spots cannot infiltrate into the soil. The depressions are too numerous and the slope too great for successful bedding, and generally tiling is not practicable or feasible.

The cross slope ditches or terraces should be constructed across the slope as straight and parallel as topography permits with limited cutting through ridges and humps. The spacing between ditches should be about 100 ft on a 1 per cent slope, increasing to 150 ft as the slope decreases to 0.5 per cent. The cross-slope ditch differs from the regular terrace in that little or no ridge is permitted on the downslope side of the ditch. This provides for ease in crossing the ditches and reduces the damage caused from overflow. The excavated material from

the ditches should be placed in the depressional areas between the ditches. Any excavated material not used in this operation should be spread out on the downhill side of the ditch so that the ridge is not over 3 in above the natural ground surface. After the excavated material from the ditches has been placed in the depressions, the area between the ditches should be smoothed or graded to eliminate all minor depressions and humps which might obstruct the free flow of surface water to the ditches.

It has been found that for ease of farming operations these ditches should be constructed with very gentle side slopes. Fig. 4 gives some recommendations.

The key to the success of this system of surface drainage is the elimination of the depressions between ditches so that no runoff will be permitted to collect and stand on the surface of the ground. With ditches spaced at regular intervals down the slope the runoff can be collected and carried away from the field. Farming operations should be parallel to the ditches. Thus, by laying out the ditches as straight and parallel as possible, ease of farming operations is provided.

#### PARALLEL DITCH SYSTEM

The "parallel ditch system" (Fig. 5) is adapted to flat, poorly drained soils in which there are numerous small shallow depressions. Quite often in the past bedding has been used on this type of soil and slope. On many soils bedding can be eliminated provided the land is smoothed or graded to eliminate all minor depressions and provide uninterrupted crop-row drainage to the parallel field ditches.

The field ditches should be parallel but not necessarily equidistant. The success of the system depends largely upon the spacing of the parallel ditches and the smoothing or grading between ditches. The land should be prepared so that every row throughout its entire length will drain to a ditch. The ditches must be spaced so that the length of row drainage from a high point to a ditch is such that the row can safely carry the runoff without much overflow or erosion damage in the row. Another factor which influences ditch spacing is the

#### CROSS SLOPE DITCH SYSTEM OF SURFACE DRAINAGE (TERRACE TYPE DRAINAGE)

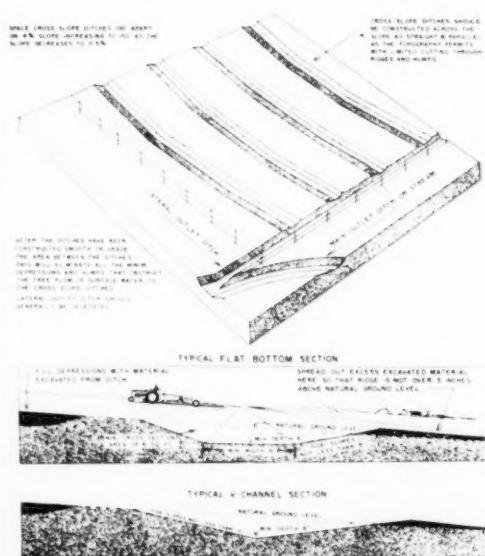


FIG. 4



such as scraper, carry-all or bulldozer is generally required. In this case, the excavated material provides two things: first, ditch capacity and, second, fill material for depression areas. The plow can be used in constructing the single ditch if the spoil on either side of the ditch will not obstruct surface flow, or if it can be leveled out in such a manner as to provide free drainage to the ditch.

The double or W ditch is actually two parallel ditches spaced a short distance apart with the excavated material placed between the ditches. In this way surface water can enter the double ditch from each side without being obstructed. It is particularly adaptable to plow construction. This ditch has application (1) where the land drains toward the ditch from both sides, (2) where the land is very flat and row drainage enters from both sides, and (3) where excavated material will not be needed for filling depressions. The ditch can be farmed across or the area between the ditches planted to some other field crops or maintained as a hay strip. The crown between the two ditches can also be used as a field road. The channels of the two ditches should be about 50 ft apart as a minimum for a channel about 9 in. deep. As the depth of channel increases the width between ditches should be increased so that a side slope of about 8:1 or flatter can be maintained.

#### LAND SMOOTHING

Land smoothing or grading has been suggested or recommended for each of the different types of surface-drainage systems. This is a relatively new drainage practice for most areas in the Midwest. All indications are that with proper use it will become one of the important factors in completely successful surface drainage in the tight soil areas.

Most of the tight soils are covered with depressions varying in size from small to large and in depth from almost nothing to a foot or more. In order to keep surface water moving it becomes necessary to ditch out these areas or fill them. It is evident that it is impossible and impracticable to ditch out all of the depressions. The larger depressions, both as to size and depth, should be ditched out. This generally leaves many one- and two-inch pockets which will collect and hold water for long periods after rains, thereby slowing up farming operations on the entire field and reducing or eliminating crop stands and yields in those depression areas. Therefore, the logical solution appears to be the ditching out of larger depressions and filling the minor depressions by land smoothing.

It is recommended that this land preparation work be spread over a two-year period or done in two operations the same year. First, rough grade the area by eye, filling the larger depressions with a bulldozer or a scraper, then operate a land leveler or plane over the entire area, which will fill many of the minor depressions. The leveler should be run over the areas from two to four times depending upon the roughness of the land. It should be operated across the area and then diagonally both ways.

After this is done a topographical survey may be needed to select and plan the type of surface drainage system best fitted for the field, then the field ditches should be located and constructed. Grade stakes should be set where additional leveling work is needed, and required cut or fill should be marked on the stakes. The cuts over 1-10 ft should then be made with a bulldozer or scraper carrying this cut material to the fill areas. After this has been accomplished, the area should then be finished with a land leveler or plane. It is not necessary that grading work be carried to a point of obtaining a uniform slope over long distances. The primary purpose is to grade the field so it will drain, filling in the depressions and removing the humps. Therefore, the slope should be broken whenever it will lessen the amount of earth to be moved.

Land smoothing will add an additional cost to any surface-drainage system, but all indications are that increased crop yields resulting from the elimination of the small depressions will pay the cost of smoothing in a relatively short time.

## The Evolution of Materials for Farm Tractors

(Continued from page 207)

wearing parts during the break-in period and also contribute to longer service without adjustment.

The design and development of new products has been speeded up by the use of improved laboratory equipment and techniques. The use of electronic equipment and electric strain gages have taken considerable mystery and guesswork out of design and test work. Wherever possible power has been substituted for human effort to the extent that the productivity per man has been greatly increased in the laboratory as well as in the factory.

We have some interesting illustrations of changes in bearing materials as used in John Deere tractors. Steel-backed, microbabbitt-faced bearings are being used to replace bronze and babbitt bearings. Aluminum is becoming more common as a main bearing material for engine crankshafts. It is a material well suited and gives excellent results with the present-day crankshafts which are heat-treated to a higher hardness than was commonly used with babbitt-type bearings. Laminated phenolic materials are replacing bronze thrust washers in many applications. During World War II our bronze piston-pin bushings were replaced by gray-iron bushings and the gray iron has continued to be used in this application up to the present time. Gray iron wears less and appears to serve equally as well as a piston-pin bushing.

Lubricants and fuels have played their part in the changing material situation. Higher strength parts running at heavier loads produce higher pressures and temperatures. Lubricants had to be developed that would perform satisfactorily under these conditions. Likewise, fuels have been improved to meet the demand of modern engines. Higher octane fuels permit the designer to get more power out of a smaller package.

Materials have been selected to give the operator greater safety and comfort on the present-day tractor. You will find plastic steering wheel, upholstered seat, rubber tires and hydraulic controls. The last-named performs many of the tasks that were formerly performed by the physical strength of the operator. The tractor of today incorporates many features and materials not found in earlier tractor models.

The materials improvement program has resulted in having an ample supply of materials to furnish machines for most of the required jobs. It has resulted in longer wear, more capacity, increased efficiency and a reduction in the servicing requirements. The small tractor of today will often do more field work than the large tractor of yesterday. We have come to expect that each new model will not only be better than the last but will deliver a greater return to the investor. The development and selection of materials best suited to the job to be performed has been an important aid in making each new design better than the last.

## Education for the Engineer

THE public not only expects a reasonable success vocationally or professionally of all college and university trained engineers, but also expects that they shall assume a certain amount of leadership in local, county, and state affairs.

It is a mistake to assume that the student who arrives on a college campus has attained from his home and secondary and high school training the competence needed in citizenship, in human relations, and in living. The option plan will permit a broad training in life and social sciences, and in the humanities.

Whether he be trained in one option or in the other, he may do research or sales work, or he may cast his lot in the field of education as a teacher. Finally, with years of experience and demonstrated ability and an understanding of the policies, personnel, finance, public relations, and other general problems of his organization, he may function in a supervisory capacity or as an executive.—E. W. Lehmann in *Journal of Engineering Education* for January, 1952.

# Fundamentals of Infrared Brooding of Pigs

By J. G. Taylor, M. T. Orem, L. P. Doyle, and C. M. Vestal

MEMBER ASAE ASSOC. MEM. ASAE

ONE of the important causes of the estimated 10 million pigs that die each spring is thought to be chilling. As little basic information appeared to be available on preventing chilling, a cooperative project between the farm electrification division of the U.S. Department of Agriculture and the Purdue University Agricultural Experiment Station was inaugurated in 1949 to study more thoroughly the supplementary heat requirements of baby pigs.

Earlier research (1)\* at Purdue University in 1942 indicated that over 50 per cent of the baby pig losses, occurring during the first ten days, in both heated and unheated pens, occurred in the first 24 hr. Work at Michigan State College (2), reported in 1948, indicated that newborn pigs have a poorly developed heat regulatory mechanism and tend to become more homeothermic after two days of age. Consequently, our studies to date have been limited to the effects of chilling during the first 72 hr of the pig's life.

## EQUIPMENT

In order to minimize the weather variable a four-pen, constant-temperature farrowing house was constructed by the Purdue university agricultural engineering department. The house was insulated with a reflective-type insulation and was located at the Purdue electric farm. Early in 1951 this building was moved inside an older one and additional insulation was added between the two buildings. Additional space was also provided to house the refrigeration compressor, temperature control and recording equipment, and to provide a heated space for the operating personnel.

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., 1951, as a contribution of the Rural Electric Division. Authorized for publication as Journal Paper No. 598 of the Purdue University Agricultural Experiment Station.

The authors: J. G. TAYLOR and M. T. OREM, respectively, agricultural engineer and asst. (agricultural engineer), division of farm electrification, U.S. Department of Agriculture; L. P. DOYLE and C. M. VESTAL, respectively, professors of veterinary science and of animal husbandry, Purdue University (Lafayette, Ind.).

\*Numbers in parentheses refer to the appended references.

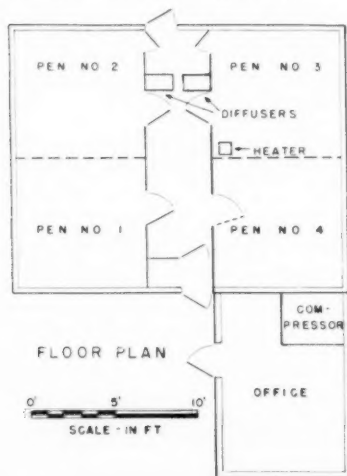


Fig. 1. Plan of constant-temperature farrowing house

A 2-ton refrigeration system was used to provide cooling. The house was originally designed to permit independent room temperatures on either side and a forced-air evaporator, independently controlled, was used for each half of the house. Heating was provided by a 1500-w electric heater in each half of the house. Temperature control, which was accomplished with two wall-mounted thermostats of a conventional type, was not satisfactory.

When the house was moved, the two evaporators were relocated at one end of the central hallway as shown in Fig. 1. By proper arrangement of the pen doors, cooling was accomplished in either, or both, halves of the house. This arrangement allowed both evaporators to be used for one-half of the house in order to obtain maximum cooling. An electronic, proportional-time controller using a thermistor sensing element was designed and built (3), and gave good temperature control. Room temperature was recorded with an electronic thermocouple potentiometer and a distant thermograph. No attempt was made to control relative humidity.

Due to the design of the cooling system, air velocities at the floor level were 50 to 75 fpm. This could very easily simulate natural drafts which are present in many farrowing houses and at any rate will provide a factor of safety in a draft-free house.

Outlets were provided for infrared lamps at the center, and in a protected corner, of each pen. A voltage stabilizer was used to maintain constant voltage at the lamp sockets. Radiation patterns were made of each lamp in the laboratory using a General Electric type DW-60 meter.

## PROCEDURE

The sows were placed in the constant-temperature farrowing house as close to farrowing as could be determined. This proved to be an extremely difficult factor to judge especially with field-bred sows. At the time of birth each pig was weighed, tagged, and its rectal temperature measured. An attempt was made to measure the latter every 5 min for the first hour, after which temperatures were taken at greater intervals for the average 72-hr period that the litter was held in the house. Initial rectal temperatures were observed with clinical fever thermometers which have some limitations be-

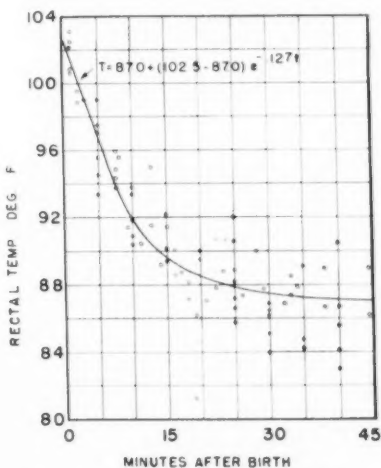


Fig. 2. Initial temperature drop, after birth, of 22 pigs

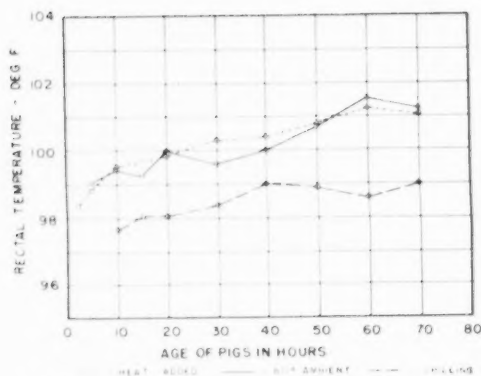


Fig. 3. Average body temperatures of three groups of pigs for their first 70 hr.

cause the lowest temperature reading is 94 F. This is not low enough to record the body temperature of a pig in a cold room. Another disadvantage is that a 2 to 4-min period is required to measure each temperature, which is too long a period for rapidly falling temperatures.

To improve the temperature measuring techniques a direct-reading thermistor bridge was built after the design of a similar instrument by Drummer and Fastic of John Hopkins University (4). This instrument gave accurate temperatures readable to 0.2 F over a range of 65 to 105 F, and required less than 50 sec per measurement.

Pigs were judged for vigor by representatives of the Purdue University animal husbandry department. Those that died from other than accidental causes were examined by the veterinary department. Usually if chilling was in evidence, as determined by observation and low body temperature, a portion, or all, of the pigs were moved to a warmer room, or heat was added, in order to prevent undue losses. No records have been kept on the pigs after they left the conditioned farrowing house; future studies may be made, however, to determine what effect, if any, various treatments on newborn pigs may have on growth.

#### RESULTS

A total of 38 sows have farrowed 329 live pigs in the controlled temperature pens to date in temperatures ranging from 20 to 60 F. Pigs used in these tests were purebred Duroc Jersey and crosses of Duroc Jersey, Chester White, and Hampshire breeds.

Fifteen litters were farrowed with no initial source of heat. At ambient temperatures of 45 F or above the pigs without heat appeared comfortable and there were no losses that could be attributed to chilling.

Small, weak pigs appeared to chill at 40 F, but one litter of strong pigs appeared quite comfortable and no losses occurred during their first 72 hr of life in a 35 F room.

**Initial Temperature Drop.** The rectal temperatures of 22 pigs from tests 21, 30, 33 and 36 for their first 45 min after birth are plotted in Fig. 2. These pigs, which did not chill, were farrowed in ambient temperatures between 30 and 40 F. Twelve of these pigs which farrowed at 30 and 35 F received supplementary heat from an infrared source at an average maximum intensity of 0.6 Btu per hr per sq in and the remaining 10 farrowed at 35 and 40 F with no supplemental heat. It was found that Newton's law applied to the initial temperature drop. The equation for the curve is

$$T = T_0 + (T_b - T_0)e^{-kt}$$

where  $T$  = temperature of the pig, deg F

$T_0$  = minimum temperature reached by the pig before it begins to rise, deg F

$T_b$  = temperature of the pig at birth, normally 102.5 F

$t$  = age of the pig, minutes

$k$  = constant

For the curve shown,  $T_b$  is 87.0 F, and the value of the coefficient,  $k$ , was found to be 0.127. The degree of correlation between the curve and the observed temperatures is 0.697, which is significant.

The value of  $k$  was observed to increase with the size of the pigs, however not enough data has been obtained to date to determine this relationship.

**Temperature Rise After Initial Drop.** Twenty to 60 min after birth a pig which does not chill will have a gradual increase in body temperature. It has been observed that pigs which begin to nurse soon after birth do not drop as low in body temperature and raise their temperature more rapidly. Actually there is probably some correlation between the time of nursing and body temperature, as pigs farrowed in cold temperatures do not seem interested in nursing until their body temperatures begin to rise.

Fig. 3 shows the average rectal temperatures of three groups of pigs, for their first 70 hr of life. The curve labeled "60 F ambient" is for tests 17, 22 and 35, totalling 28 pigs which had farrowed in 60 F ambient with no supplemental heat. The "heat added" curve is an average of 42 pigs from tests 9, 11, 12, 15 and 16 which were farrowed in temperatures of 30 and 35 F, but which had enough supplementary heat to prevent chilling. It may be noted that these two curves are nearly identical and a temperature of over 101 F is reached in 60 hr.

The curve labeled "chilling" is for 21 pigs from tests 3, 4, 23 and 24 that farrowed in ambient conditions of 35 and 40 F without supplementary heat. Losses which were attributed to chilling occurred in these litters, but the temperatures of those pigs that died are not included in the average curve shown. Temperatures of these pigs started lower but increased at about the same rate as the warm pigs until they reached 99 F at 40 hr of age when they leveled off. At 70 hr of age their temperature was still 99 F and apparently it would require considerable time for these pigs to reach the normal temperature of 102.5 F.

**Chilling at 20 F.** The curves in Fig. 4 are individual body temperature curves for 8 pigs of test 27, farrowed in a 20 F ambient temperature without supplementary heat. Four pigs

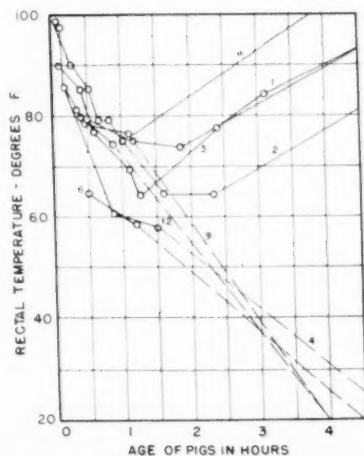


Fig. 4. Individual body temperatures of 8 pigs of test 27 farrowed in a 20 F room without heat. Pigs numbered 4, 6, 9 and 12 died within 5 hr after birth, but the remaining pigs were revived with radiant energy applied 1 to 2 hr after birth.

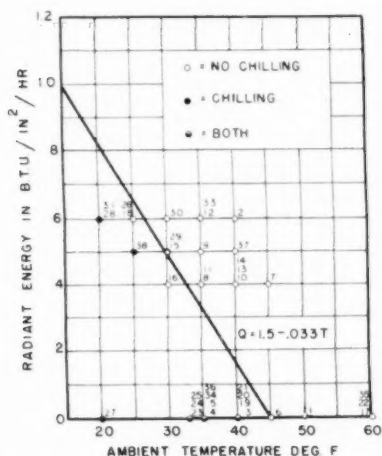


Fig. 5. Results of all tests showing the amount of radiant energy at pig level versus ambient temperatures and whether chilling was apparent. The numbers at each point indicate the numbers of the tests. The curve was drawn to separate the tests where chilling was apparent from the tests where chilling was not apparent.

were left in the room until they died, death occurring in 4 to 5 hr after birth. The remaining four pigs were moved to a 70 F room after their temperatures had reached temperatures as low as 65 F. It was quite difficult to detect if the pigs were dead or alive at this stage; they were stiff, inactive and respiration was barely noticeable. Two 250-w infrared lamps were placed over the pigs in the 70 F room and after approximately 4 hr the pig's rectal temperatures had reached 100 F; they were quite active and "squealing" for food. These pigs were then returned to their mother in a room at 65 F where they were kept until they were moved outdoors at an average age of 82 hr. These pigs gained in weight and appeared normal and healthy with the exception that most of them had badly frozen ears.

**Heat Requirements.** The results of all tests plotted in Fig. 5 indicate the average maximum intensity level of the infrared lamp at floor level, if used, and whether chilling did or did not occur at the temperatures and treatment of the test. The numbers by each point indicate the numbers of the tests. Where both chilling and non-chilling occurred this indicates that more than one test was used and pigs in at least one litter chilled, while those in the replica did not.

A straight line was drawn through these points, separating the tests which chilled from those that did not chill. It may be noted that although no pigs in any litter which farrowed under conditions to the right of the curve, chilled, some pigs did not chill in tests under conditions indicated to the left of the curve. If heat is supplied at the rate indicated, it should be sufficient for the weaker pigs, although it may be slightly more than is necessary for the stronger pigs. The equation for this curve is  $Q = 1.5 - 0.033T$ , where  $Q$  = the intensity of radiation required in Btu per square inch per hour at pig level for a given room temperature,  $T$  (deg F).

Although the amount of heat required may be decreased as the pigs grow older, this is usually not feasible with infrared lamps, except for possibly very cold temperatures where more than one lamp is used at the time of farrowing. Although no tests have been conducted, it is believed that supplementary heat would seldom be required to prevent chilling in pigs that are over one week of age.

The temperatures indicated in these tests are the air temperatures at pig level away from any radiant source. In a

tightly constructed house, indoor temperatures several degrees above outdoor temperatures would normally be experienced due to the heating effect of the sow and litter, and auxiliary heating source, if used.

**Location of Infrared Sources.** The recommended radiation level on the pigs at various ambient temperatures is shown by the curve in Fig. 5. It is important that the energy be directed on the pigs because of the limited heating effect of the infrared lamps on the air. Newborn pigs will not select a warm spot in the pen to keep warm; the heat must be brought to them or they must be brought to the heat. If a heating source is used in a protected corner, it is doubtful that this will be of any value to a pig for the first 5 hr of its life when it is most susceptible to chilling, unless the operator places the pig in the corner under the heat source and keeps it there.

It is therefore recommended (5) that a heating source be placed so that it will provide heat to the pigs as they are born and while they are nursing. Usually a sow will lie under the infrared lamp which is placed in the center of the pen. This is not always true, however, and it may be necessary to provide more than one heated spot in a pen in order to make certain that the newborn pigs will receive the necessary supplemental heat. The useful heated area on the floor of a 250-w R-40 infrared lamp mounted 36 in high, is a circle of about 24-in diameter.

After the pigs are about 12 hr old the infrared lamp may be moved to a protected corner, and if the pigs are confined under the lamp for a few minutes they will ordinarily learn where the heat source is and will spend a good portion of the time in this corner. A principal advantage of the protected corner is that it materially reduces the chance a sow has of lying on the pigs. It is not recommended that the infrared lamp be lowered in the corner to obtain radiation levels substantially higher than those shown by the curve in Fig. 5.

#### CONCLUSIONS

A newborn pig farrowed in a cold room will lose heat according to Newton's law of cooling during its initial temperature drop.

Pigs which do not chill will drop to a minimum body temperature in 20 to 60 min and then gradually rise in body temperature until they have reached their normal in two to five days.

Pigs may be "revived" with liberal applications of radiant energy after their body temperature has reached temperatures as low as 65 F.

Auxiliary heat should be supplied in farrowing pens at temperatures below 45 F.

The intensity level,  $Q$ , of infrared energy at pig level required, in Btu per square inch per hour, to prevent chilling in newborn pigs is given by the relationship  $Q = 1.5 - 0.033T$ , where  $T$  = the temperature (deg F) of the room. This is not to be used as an exact rule but may be useful as a working tool in designing infrared brooding installations.

It is important that the radiant energy sources be directed onto the pigs, especially for the first few hours of life.

Protected corners with infrared sources are particularly useful after the pigs are 12 to 24 hr old, both for protection against chilling and from overlaying by the sow.

#### REFERENCES

1. Foster, G. H., and Vestal, C. M.: The Use of Electric Heat in the Farrowing Pens of Young Pigs. Purdue Agricultural Experiment Station Bulletin 494 (1944).
2. Wallach, D. P., Newland, H. W., and McMillen: Some Studies on the Temperature Adaptation in the Baby Pig. Michigan Agricultural Station Quart. Bulletin, vol. 30, no. 3 (1948).
3. Taylor, J. G.: Electronic Temperature Controller for Experimental Swine Farrowing House. Unpublished master's thesis, Purdue University (June, 1951).
4. Drummet and Fastic: A Simple Resistance Thermometer for Blood Temperature Measurements. *Science*, page 72, vol. 105 (1947).
5. Taylor, J. G., and Orem, M. T.: Save More Pigs with Heat Lamps. Purdue Agricultural Extension Leaflet 318 (1951).

## Heating Water with a Milk Cooler Using the Heat-Pump Principle

By L. F. Charity, V. H. Baker, and U. F. Earp

ASSOCIATE MEMBERS ASAE

MEMBER ASAE

**A** MECHANICAL wet tank farm milk cooler is usually equipped with an air condenser. This means that the air in the milkhouse, passing through the condenser, indirectly absorbs the heat from the milk in the milk cooler. Removal of this heated air from the milkhouse is a problem in many sections during the warmer seasons.

A water heater usually is also installed in the milkhouse to provide hot water for cleaning utensils. Since both the milk cooler and hot water heater are usually necessary and are often installed in close proximity to each other, a method of reducing the cost of operation of the water heater, and in some cases eliminating unnecessary milkhouse temperatures, suggests itself. Preliminary study indicated that a properly designed condensing coil, which would replace the air condenser of the milk cooler refrigeration system, could be placed in an insulated tank, and thus be utilized as a water-heating device. With this arrangement, tap water would pass through this tank and be preheated by the condensing coil before entering the conventional water heater. Freyder's reports (1,2)<sup>1</sup> relative to the successful use of the heat-pump principle to heat domestic water indicates that the above arrangement has merit. Other work in connection with heating water through application of the heat-pump principle includes Otis (3) which involved the use of heat extracted from a domestic food freezer.

Theoretically, the daily heat loss through a 4-can milk cooler and the heat given up by cooling four 10-gal cans of milk from 90 to 40 F amounts to approximately 21,000 Btu. If all this heat could be used to heat water, in every 24-hr period approximately 16 gal of water could be raised in temperature from 60 to 115 F. In addition, considerable heat would be added to the refrigerant by the sealed-in compressor motor, which should provide additional capacity. This preheated water could then enter the electric water heater to be raised to 150-160 F. By this arrangement, an appreciable saving on the cost of operation of the electric water heater may be effected.

With these considerations in mind, a study was undertaken, using a 4-can milk cooler, to determine if water could

be effectively preheated with the heat normally dissipated by the condenser of the milk cooler.

**Design Conditions.** The following conditions were considered reasonable in this study:

1. The average temperature of milk placed in a milk cooler is approximately 90 F.

2. A dairy farm producing four 10-gal cans of milk per day might reasonably use 68 gal per day of 150 to 160 F water for washing, rinsing, and sterilization of utensils. This 68 gal of water could be expected to be drawn during the two milking periods at the rate of 34 gal for each period.

3. A dairy farmer might be so located on the route of the pickup truck that the two cans of milk produced in the morning would remain in the milk cooler for an hour along with the two cans which would have been placed in the cooler the previous night.

4. Water in the range of 90 to 40 F has approximately the same heat content as milk at this same temperature. Thus, water was substituted for milk in the tests.

**Major Equipment.** A 52-gal electric water heater having 3 in. of fiberglass insulation was used (Fig. 1). Both the 1500-w upper heating unit and the 1000-w lower unit were controlled with individual thermostats. The milk cooler was a 4-can, 1/4 hp, Unico model, using F-22 refrigerant. The preheat tank consisted of a conventional 30-gal water tank around which 2 in. of mineral wool insulation was placed. Temperatures were recorded with a 16-point strip chart potentiometer.

The milk cooler and water heater were operated as separate units for the first series of tests. For the second series of tests, a condensing system consisting of a preheat tank with a copper coil condenser was designed as a substitute for the air condenser. A thermostatically controlled solenoid valve, set to discharge water at 120 F, was installed at the top of the preheat tank as a safety measure. The cycles of operation for the cooler and water heater, energy consumption, etc., were recorded for all tests. The maximum high-side pressure for the preheat tank arrangement was 270 psig.

**Results.** At no time during any of the tests was the 1500-w upper unit of the water heater required to operate.

(Continued on page 219)

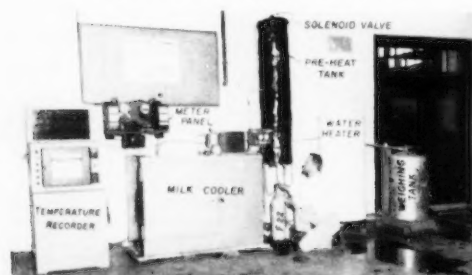


Fig. 1 Equipment used in tests showing temperature recorder, milk cooler, meter panel, preheat tank, water heater, and weighing tank.

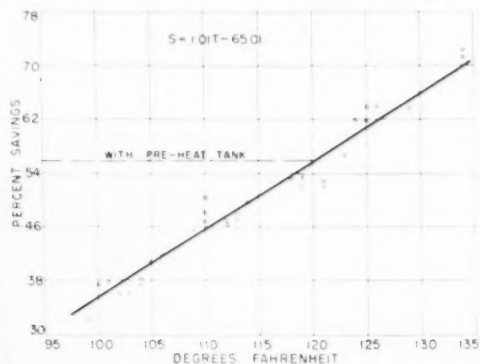


Fig. 2 Relationship between per cent saving in water heater kilowatt-hour consumption vs. entering temperature for 68 gal of approximately 150 F water in 24 hr. Dotted line shows per cent savings with preheat tank water temperature of 120 F. Per cent savings were computed on the basis of normal energy requirements to heat water from 60 to 150 F.

# Control of Wood Decay in Buildings

By A. F. Verrall

THE lasting qualities of properly designed and constructed wooden buildings are apparent from the many houses in all parts of the country that have lasted for many, many years. Yet many of us know of buildings in which repairs, sometimes costly, were needed because of decay. Decay is almost always a sign of faulty design or construction or of a lack of reasonable care. The factors responsible for decay in buildings are not well enough known to many architects and builders and still less to the general public.

In most houses, decay causes little or no damage. Serious decay is like fire, in that it affects relatively few houses but when it does occur the damage may be costly to repair. Many houses with glaringly poor construction, with faults known to invite serious decay, never become infected. We cannot predict which carelessly built houses will be damaged. The safe thing is to see that decay-inviting faults are not present. Oftentimes dangerous features are unintentionally built into a house from a lack of knowledge of the basic causes of decay.

Other structures of wood such as barns, silos, and machinery sheds on farms also are subject to decay unless constructed properly. The factors that lead to decay in them and the measures that are needed to avoid or correct decay are the same as those for houses.

**How to Avoid Decay.** Decay is the breaking down of wood as a result of fungi feeding upon it. The decay fungi may not be visible to the unaided eye, and we may not know they are present until the damage is done. Fungi, being plants, require suitable food and moisture to grow. Control of decay is accomplished by making one or both of these factors unfavorable for fungus growth. The food, i.e., the wood, can be rendered unsuitable either by poisoning it with wood preservatives or by using heartwood of naturally durable woods in decay-vulnerable parts of structures. The practicability of these methods of decay prevention is limited in most buildings. By far the most widely applicable method is to keep the wood too dry to support growth of rotting fungi. When wood is air-dry or kiln-dry, it will not decay. However, if dry wood is in contact with the soil or moist masonry, or is wetted by leaks or sweating, it may again become moist enough to decay. Therefore, the most fundamental principle in avoiding decay in buildings is: *Build with dry wood and keep the wood dry.*

**The Use of Good Lumber.** Much of the wood available during the past decade is less durable than the virgin timber we used previously. Stocks of highly durable species are decreasing and we must depend on lumber from less durable species, or of part sapwood. Sapwood is more subject to decay for two reasons: (1) it absorbs water much more quickly than heartwood, and (2) it lacks the natural preservative chemicals that are contained in the heartwood of the more durable species.

The lumber now generally available will make good buildings, but we must be more careful in using it. The use of green (unseasoned) lumber during building emergencies has been unfortunate. From a decay point of view, wood that isn't fully seasoned is safe as framing or sheathing if it has had a chance to dry out rapidly during or after construction. In drying after construction, however, unequal shrinkage may result in such defects as plaster cracks, binding of doors, and uneven floors. When siding and exterior trim is involved, drying may open cracks into which rain can seep, resulting in decay or other moisture-induced problems. If drying is not rapid after construction, the use of green lumber can lead to disastrous decay.

Another quality of good lumber is freedom from infections by mold, stain, and decay fungi. Molds and stain cause no appreciable weakening, but since they develop under the same general conditions as decay fungi, the presence of molds or stains is grounds for suspecting the presence of a decay fungus also, even though it has not developed to a point where it is obvious.

There are two reasons why lumber infected with fungi, whether stain, mold, or decay, is a poor risk for exterior woodwork. First, air-drying doesn't kill all fungi in wood. Many will live for weeks or months and some for years in air-dried wood. So long as the wood is dry these fungi remain dormant, but when wetted they will revive. If water seepage occurs regularly, the fungi may grow out through the paint, causing unsightly discolorations. If a decay fungus is present, it will make further progress at each prolonged wetting and the board may eventually need replacement. In the second place, infected wood will absorb water more readily than noninfected wood. This combination of greater water absorption and a decay fungus already present in the wood is undoubtedly one of the main reasons why some siding develops extensive decay when structural designs favor wetting or hinder drying.

During the past few years entirely too much stained and decay-infected lumber has reached the market. The methods of producing fungus-free lumber are well known and economically feasible (5)\*. In fact, during the middle 1930's, effective fungus control was the rule rather than the exception. Fungus-free lumber can be produced either by kiln-drying or by the use of sap-stain control dips followed by air-seasoning. Kiln-drying with the usually recommended schedules will sterilize wood, i.e., kill any fungi already present. However, if kilning is delayed until fungi have had a few weeks to develop, kiln-drying will be only partly effective. It will kill the fungi present, but the lumber may retain its increased water-absorbing properties.

The production of fungus free lumber is only the first step necessary in getting the proper wood into buildings. After seasoning and manufacturing, the lumber must be protected from wetting during the merchandising process and at the building site. Improper storage or handling anywhere along the line can lead to water absorption and infection.

**Site and Substructure.** The site and substructure are closely related as far as decay is concerned. A building on a dry site with the surface sloped away from the house to prevent surface water accumulating around or under a building will be relatively safe from substructure decay. Poor drainage is likely to mean a wet basement or wet soil under a building. Decay will not necessarily result, but decay hazards from other faults may be accentuated.

The decays causing most extensive damage and those most costly to remedy have their origin in the area of the sills, joists, and other parts below the first floor. Particularly dangerous are: (a) unprotected sills in contact with dirt fills for porches, terraces, or steps; (b) wooden forms left on poured concrete steps, porch slabs, or foundations; (c) any sills, joists, or other non-durable wood in direct contact with the soil, and (d) steps or partitions, particularly if enclosed, or wooden floors directly on moist concrete slabs. These features are those most commonly found associated with the destructive fungi that form water-conducting strands to carry water from the soil or other source of water to wood normally too dry to rot.

Aside from direct soil water through wood-soil contacts, wet soils can indirectly wet wood through condensation. The commonest condensation occurs during cold weather when wet warm air of the crawl space strikes the colder wood of sills, headers, and outer joist ends. Less common is summer condensation, which usually seems to occur at the center of substructures and not at the periphery as does winter condensation.

\*Numbers in parentheses refer to the appended references.

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The author, A. F. VERRALL, pathologist, division of forest pathology, Bureau of Plant Industry, Soils and Agricultural Engineering, U.S. Department of Agriculture.

The control and prevention of substructure decay is mainly a problem of controlling moisture. All contacts of untreated wood with the soil should be removed. Condensation can be prevented either by adequate ventilation or by the use of soil covers (2). A number of formulas have been devised to express adequate amounts of substructure ventilation. The  $2 \div 1$  formula is the one usually recommended. This calls for vent openings through the foundation having a net unobstructed area equal to 2 sq ft for each 100 ft of outside wall plus  $\frac{1}{2}$  sq ft for each 100 sq ft of crawl-space area. Where the soil is continuously dry, this amount of vent area is probably more than is needed and the only cases where we have found the  $2 \div 1$  formula inadequate have been in brick veneer houses where wet crawl space was connected with the air space between the veneer and the frame. The best construction seals the air space between a brick veneer and a frame wall from the crawl space air.

The biggest drawback to sole dependence on foundation vents to prevent condensation is the fact that the greatest need occurs during the winter. In cold climates adequate ventilation may lead to cold floors or freezing of pipes. Consequently, when wet soils cannot be corrected by soil drainage, the use of soil covers has proved very useful for cold climates (2). The principle involved is the use of a vapor barrier over the soil to reduce the humidity of the crawl space. Asphalt roll roofing weighing 55 lb per roll of 108 sq ft is a satisfactory soil cover. The edges are overlapped 2 in but no fastening, cementing, or preliminary leveling is necessary. Such soil covers have stopped condensation even when no substructure ventilation is provided.

Frame houses built on concrete slabs resting on the ground pose special problems. Such slabs need moistureproof layers either above or below the concrete so that all wood laid on the slab remains dry. Best practices also call for wood treated with a preservative for wall plates and strips to which flooring is nailed. The top of the slab should preferably be 8 to 12 in above grade line.

**Exterior Woodwork.** Most decay in siding and exterior trim is that resulting from seepage of rainwater into joints. If wood siding extends to the ground, more serious decay may result. Wood siding and trim should be at least 6 in above the soil. Window and door trim or any other projections from the wall need flashing at the top unless protected by roof overhang. All joints should fit snugly and the whole exterior should be designed so that water will run off quickly with a minimum of soaking into joints (Fig. 1). Extensive surveys in the Southeast disclosed (4) that most serious decay of siding and exterior trim was associated with the following:

1. Narrow roof overhang. Many houses have good eaves projection but little projection at the gable ends. An overhang of 8 in seems beneficial and overhangs of 20 in or more seem to offer almost complete protection in one-story buildings.
2. Vapor-barrier papers used as sheathing papers between

wood siding and sheathing or studs. The functions of sheathing papers are to turn liquid water and prevent wind leakage. However, they should be readily permeable to water vapor. If rainwater wets siding, it will seep into butt joints between siding and trim and between siding boards. With a painted exterior any water seeping back of siding must dry largely to the inside, hence the need for breathing paper.

That vapor-barrier papers, used as sheathing papers, dangerously retard drying of siding wetted by rain seepage has been shown in experimental siding panels at Saucier, Miss., and by observations on a project in Florida where 246 houses were built, all of the same design. Paper was omitted from under the siding in forty of these houses and a vapor-barrier paper was used in the other 206. Serious decay developed in the siding of the latter houses but practically none in the first forty.

The following papers are, in general, too vapor impervious for use under wood siding: asphalt-coated papers, asphalt-saturated but uncoated felts of 15 lb or more per roll of 108 sq ft, laminated papers with asphalt cores, and papers surfaced with aluminum foil. Vapor-barrier papers do have a proper use, particularly in the north on the warm side of walls, but not directly under wood siding. Breathing papers for use under siding can be determined with surety only by tests, but in general the asphalt and tar-saturated but uncoated felts of light weights (considerably less than 15 lb per 108 sq ft) are satisfactory. These are included in sheathing papers labeled Class D.

3. Incipient decay infections already in the lumber at the time of construction. This point is hard to prove, but all the evidence points to this as one of the prime factors needed for extensive decay of siding and exterior trim.

4. Roof designs that permit the discharge of large amounts of water directly against wooden walls or allow water to splash up onto exterior woodwork. Clogged or broken gutters or downspouts can have the same effect.

**Condensation in Walls.** There is abundant evidence that heavy condensation can occur within walls during the winter in cold climates. Such condensation can lead to such troubles as paint failures, but there is little information on decay associated with this type of condensation. The prevention of wall condensation is accomplished by placing a vapor barrier on the warm side of the wall (1). An analogous trouble occurs in dairy barns. There the usual control is through proper ventilation.

**Porches and Exterior Steps.** Wooden porches, exterior steps, and loading platforms, unless unusually located to prevent rain wetting, present the greatest decay hazard of any part of the ordinary building. This hazard can be reduced somewhat by sloping floors to the outside and allowing drainage holes under screen frames. With the present difficulty in getting all heart lumber of durable species, wooden porches, steps, and

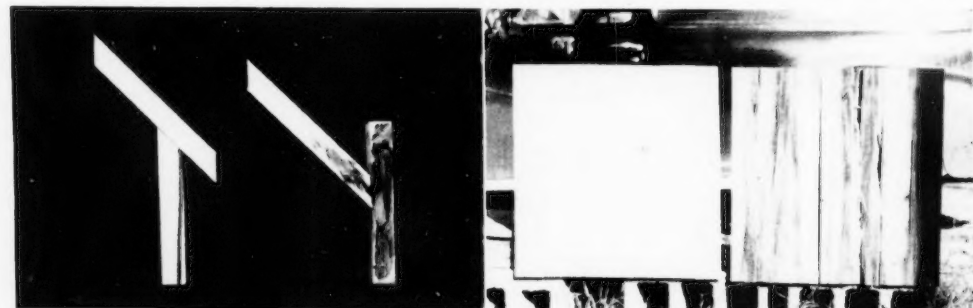


Fig. 1 (Left) All joints in exterior woodwork should be designed so that water will run off quickly with a minimum of soaking into joints. The experimental step rail on the left, extending over the top of the newel, minimized water seepage. The rail on the right nailed to the side of the newel permitted heavy seepage, promoting early decay. • Fig. 2 (Right) On the job applications of preservatives can increase the service life of exterior woodwork off the ground but exposed to rain seepage. Shown here are experimental porch flooring units fully exposed for 2½ yr. The unit on the right was untreated, that on the left given a 3-min dip in 5 per cent pentachlorophenol in mineral spirits plus a moisture repellent.

similar structures are best protected by the use of preservative treatments.

**Preservative Treatments.** Whenever preservative-treated wood is needed in a building, lumber commercially impregnated will give the best protection. A number of preservatives are available that leave a clean paintable surface and are suitable for use on exterior woodwork of buildings. Lumber impregnated with such water-carried preservatives as zinc chloride, chromated zinc chloride, Wolman salts, and Celcure, are available to the general building trade in some localities. For sills, joists, and other parts to be left unpainted and where odor will not be objectionable, creosote of course is satisfactory. However, in many localities commercially impregnated lumber is unavailable, at least in a sufficient variety of items, or is too costly to make it generally usable in building construction except for limited special uses. This frequently necessitates the use of on-the-job treatments of such oil-carried preservatives as pentachlorophenol, copper naphthenate, and phenyl mercuric oleate. These non-pressure treatments, even though not as good as commercially impregnated lumber, are well worth while where there is any considerable decay hazard (4) (Fig. 2). This is particularly true if the worst decay hazards are eliminated by the building designs and construction features previously mentioned in this paper. These simple treatments are not recommended for severe conditions such as wood in contact with the soil but only for the protection of wood off the ground but exposed to rain seepage.

#### APPLICATION OF A GOOD PRESERVATIVE IS WORTH WHILE

Any application, if properly done, of a good preservative is worth while for protection against decay of exterior woodwork off the ground but subject to rain seepage at joints. The degree of protection will be least with brush applications, better with dip treatments, good with soaks of 15 min or more, and best with complete impregnation by commercial treatment.

In using brush, dip, and short-period soak treatments several precautions must be taken:

- 1 Most on-the-job applications offer only surface protection, and it is imperative that the lumber be cut to size and shape before treatment; otherwise untreated wood will be exposed and subject to infection. If any cutting is done, the exposed surfaces should be re-treated. Recent results show that wood given a brush or 3-min dip treatment will not give good service as exterior woodwork unless the wood is painted with an oil paint or a moisture repellent is incorporated in the preservative. Either of these will reduce surface checking and resulting internal decay.

- 2 Satisfactory treatment with oil solutions requires that the wood be thoroughly dry before treatment. Wood with moisture content below 20 per cent can be treated satisfactorily. Water-carried preservatives are generally less suitable than oil-carried ones for on-the-job treatment.

- 3 In most cases the greatest decay hazard in exterior woodwork is at end cuts involved in joints. If at all feasible, end cuts should be soaked in the preservative. Pieces too long to be completely immersed in the preservative are best end-dipped or soaked and the sides given two brush coats with the preservative flowed on and not merely painted on.

The paintability of wood treated with pentachlorophenol, copper naphthenate, or phenyl mercuric oleate is determined primarily by the oil carrier used. Mineral spirits is one of the best carriers to use on wood to be painted but kerosene can also be used. Heavier fuel oils are recommended only for wood to be left unpainted. Treating solutions will discolor paint if the paint is applied before the oil evaporates.

Some of the concentrates of the preservatives on the market contain heavy oils and even when diluted with mineral spirits will discolor paint applied as soon as a week after treating. When only small quantities of preservative are needed for wood that is to be painted, it is best to buy ready-to-use solutions designed for treating millwork. If a concentrate is purchased it should be one labeled suitable for millwork use.

Exterior woodwork most frequently needing preservative treatment and for which on-the-job treatments are worth while include:

Steps — treads, stringers, risers.

Porch — floors, outside joist, trim.

Rails — step, porch, stoop.

Sash and casings exposed to rainwash.

Garage doors, particularly outward swinging doors left open during the day.

Roof sheathing — lower board if no metal flashing is used.

Ends of diagonal sheathing or the bottom board of horizontal sheathing close to the ground. This need is mostly limited to ground-line concrete slab construction in which the siding is less than 12 in from the soil and subject to wetting by rain splash.

Siding and trim if subject to frequent rainwash.

Pickets and rails for fencing. Fence posts need thorough impregnation.

**Maintenance and Decay.** The lack of proper maintenance can lead to decay. Where weather requires the closing of vents during the winter, they should be opened as soon as feasible in the spring. If condensation has occurred during the winter, the addition of a soil cover should be considered. Leaky or clogged eaves gutters and downspouts should be corrected promptly. Care should be exercised in building up flower beds so that no siding-soil contacts will be created. Also, too dense shrubbery close to a building can aggravate a decay hazard. Oftentimes serious decay can be prevented by frequent inspections of crawl space, basements, and exterior woodwork. A small repair bill at the start may prevent heavy damage a year or so later.

#### REFERENCES

- 1 Anonymous. Condensation control in dwelling construction. Housing and Home Finance Agency. Unnumbered bulletin, 1949.
- 2 Diller, J. D. Reduction of decay hazard in basementless houses on wet sites. U.S. Dept. of Agric. Forest Path. Special Release No. 30, 1950.
- 3 Verrall, A. F. Decay protection for exterior woodwork. *Southern Lumberman* 178 (no. 2257): 74, 76-78, 800, 1949.
- 4 Verrall, A. F. Decay of wood siding is preventable. *Southern Lumberman* 182 (no. 2274): 55-57, 1951.
- 5 Verrall, A. F. and Scheffer, T. C. Control of stain, mold, and decay in green lumber and other wood products. *Proceedings of Forest Products Research Society Proc.* 3: 480-489, 1949.

## Heating Water with a Milk Cooler

(Continued from page 216)

The milk cooler consumed an average of 7.45 kw-hr of electricity in 14 hr and 24 min of operating time out of the 24 hr with the air condenser in the refrigeration system. When the coil in the preheat tank was substituted for the air condenser, no significant difference in either the total operating time or the total energy consumption of the milk cooler was observed.

In the conventional arrangement, the water heater consumed an average of 17.13 kw-hr of electricity in an average of 15 hr and 5 min of operation, when 68 gal of 150 F water were withdrawn in 24 hr.

The water heater consumed an average of 8.45 kw-hr of energy when raising 68 gal of water from 120 to 150 F in 24 hr. Under these conditions tap water at 60 F was raised to 120 F in the preheat tank before entering the hot water heater. Therefore, better than 50 per cent of the electrical energy was saved by placing the refrigeration condenser in the preheat tank.

In order to estimate the savings in the cost of electrical energy required for the water heater when preheat tank water temperatures were other than 120 F, a series of tests were run in which water of 95 F to 135 F was admitted to the water heater. Results are shown in Fig. 2. The procedure used in other tests for drawing 68 gal of 150 F water in 24 hr was followed.

#### REFERENCES

- 1 Freyler, G. G. "Heat Pump Domestic Water Heater," *Heating and Ventilating*, July, 1951.
- 2 Freyler, G. G. "Domestic Water Heater Employs the Heat Pump Principle," *Electric Light and Power*, vol. 29, August, 1951.
- 3 Ora, Haimie. "Supplementary Water Heating with Domestic Freezer Compressor," University of Minnesota thesis, December, 1950.

# Results of Sorghum Grain Storage Studies

By J. W. Sorenson and M. G. Davenport

MEMBER ASAE

ASSOCIATE MEMBER ASAE

**S**TORAGE of sorghum grains on the farms of South Texas (the Gulf Coast area of the state) has long been a problem to farmers of that area. Lack of proper facilities and thorough understanding of the problems that go with such storage have been the chief reasons why those farmers, year after year, were forced to sell their grain during the production season and then buy it back when prices were higher.

The problems of conserving stored grain vary from one section of the country to another. However, the problems of storage are intensified in South Texas where high temperatures and humidity and danger of severe insect damage make the storage of grain very hazardous. Most of the grain is high in moisture when harvested and must be dried artificially before it can be stored without the hazard of spoilage from heating.

In 1917 tests were conducted at Corpus Christi by the Texas Agricultural Experiment Station to obtain basic engineering data that would enable farmers to dry their grain on the farm more efficiently. These tests were expanded in 1948 to include research on the problems involved in storing the grain on the farm. These experiments are centered at the Beeville Station and are being conducted cooperatively with the Production and Marketing Administration (USDA), the Corn Products Refining Co., and the Great Lakes Steel Corp. The following discussion and recommendations are based on the results of these investigations.

## FACTORS TO CONSIDER FOR SAFE STORAGE

Results to date indicate that the moisture content and the amount of foreign material (i.e., stems, leaves, grass seeds) in the grain are the primary factors to consider for safe storage. High-moisture conditions and excessive trash are conducive to insect, heat and mold damage, and thus appear to be the basis for most of the problems encountered in storing sorghum grain.

**Safe Moisture Content.** A moisture content above 12 per cent appears to be too high for safe storage. Grain with a moisture content of 12 to 14 per cent usually heated after a few weeks storage and required turning during the summer months to keep it in good condition. On the other hand, a moisture content of 10 to 12 per cent appears to be low enough for safe storage. Grain in this moisture range has been stored for as long a period as 24 months without turning or forced air circulation.

**Foreign Material.** Data obtained during the past two years show that excessive foreign material (trash) will cause heating even though the moisture content of the grain is below 12 per cent. The stems and leaves of sorghum plants are usually higher in moisture than the grain at the time of harvest. Since this material is lighter in weight than the grain, it accumulates in pockets as the grain is loaded. The resultant heating of this high-moisture material makes favorable conditions for the development of insect activity in the adjoining grain. The insects then liberate more moisture through their respiratory processes which in turn causes the grain to heat. Thus an unending cycle is set up that eventually causes insect infestation and accompanying spoilage throughout the bin. Control by aeration and fumigation then become necessary. Proper adjustment of combines to deliver clear grain at harvest seems to be the practical remedy for this problem.

**Reducing the Moisture Content.** It is desirable to delay the harvest until the grain is dry enough to store safely. However,

weather conditions at the time of harvest in South Texas are often such that it is impractical to leave the crop in the field until dry enough to permit immediate storage. Even with favorable weather conditions it is difficult to field-dry the grain below 15 to 14 per cent moisture. As a result, it is usually necessary to reduce the moisture content to the safe storage level by some method of artificial drying.

Sorghum grain has been successfully dried in column-type driers, bin driers and trailers equipped with false floors.

**Column-Type Drier.** A batch-type column drier designed and tested by agricultural engineers of the Texas Station has proved to be a very successful and economical means of drying grain on the farm. Instructions for building and operating this drier can be obtained by writing the Department of Agricultural Engineering, Texas Agricultural Experiment Station, College Station, Texas.

The fastest rate of drying and the lowest costs for power and fuel were obtained with this unit when the velocity of the air through the grain columns was 80 to 90 fpm. The air temperatures found to be the most efficient for drying the grain to 12 per cent moisture were 150 F for grain with 14 to 16 per cent moisture; 175 F for grain with a moisture range of 17 to 20 per cent; and 200 F for grain above 20 per cent moisture. The costs per ton for electric power and natural gas fuel ranged from 20 cents for grain with 14 to 16 per cent moisture to 40 cents for grain with 22 to 24 per cent moisture.

**Bin Drier.** Bin-drying tests indicate that it is impractical to dry grain in bulk several feet deep when the time element is the important factor. Bin drying is suitable for producers who intend to store their grain in the same bin in which it is dried, however. It has been found that grain with a maximum moisture content of 16 per cent can be successfully dried with an air temperature of 120 F and an air velocity of 50 fpm when the depth does not exceed 5 ft.

A bin drier can be used to obtain a capacity sufficient to keep up with the combine harvesting operation when the depth of the grain on the drier does not exceed 10 in. Mechanical elevating equipment for loading and unloading will be required in this case, however.

**Trailer Method.** Farm trailers equipped with subfloors and using portable fan and heating units were used successfully by a number of farmers in 1950. This method is recommended for custom operators or for farmers who have crops over widely separated areas. The most efficient results were obtained when the depth of the grain did not exceed 10 in. The air requirements for this method of drying are the same as those recommended for the column-type drier.

**Insect Control.** It is extremely difficult to control insects in the South Texas area. However, tests show that insects can be most effectively controlled when the moisture content of the grain does not exceed 10 to 12 per cent. Reducing the moisture content to this level will not completely eliminate the insect problem, but will usually reduce the number of treatments required to control the insects. The most effective control measures have been accomplished by fumigating the grain at the beginning of the storage period and then refumigating when necessary.

A mixture of three parts ethylene dichloride and one part carbon tetrachloride by volume has been effective in controlling weevils.

**Germination.** Heating of the grain during storage, insect damage and mold development, or a combination of these factors, appear to be the primary causes for reduction in germination.

There were some signs of mild heat damage in nearly all of the bins in 1950-51. This information, together with the temperature records to date, indicate that temperatures over 85 to 90 F for a prolonged period have a detrimental effect on

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the germination of the seed. Aeration of the seed by forced-air circulation may be the most practical way to maintain these temperatures.

A great deal of difficulty was encountered with mold development during the germination tests. Four genera of molds were present that were probably initiated by the high moisture conditions. These molds are universally present in the air and apparently the moisture in the grain made optimum conditions for their development. This indicates that the mold development started during storage and their activity increased under the higher moisture conditions required for the germination tests.

These factors emphasize the importance of storing clean seed with a moisture content below 12 per cent and then making every effort to prevent insect damage during storage.

#### STORAGE BINS

**Wood and Steel Bins.** Wood and steel bins have proved to be satisfactory storages. Tight construction is essential, however, to exclude outside moisture and to prevent the escape of the fumigant used for insect control. For short-time storage (less than one year), this can be accomplished by lining the inside of single-wall wood bins with reinforced paper or roll roofing. For long-time storage or when the bins are to be used for grain storage year after year, the recommended construction is to line the inside with plywood or similar material. Caulking the joints of round steel bins has been satisfactory for making these bins moisture-tight.

**Temporary Storages.** Grain was stored in two temporary bins constructed of Protekwood in 1949. Protekwood is a 1/12-in hardwood veneer with 0.030-in asphalt and resin impregnated faces, laminated under heat and pressure. The board is black with an over-all thickness of 1/2 in. It is a comparatively low-cost material that is moisture resistant. One of the bins was 11 ft in diameter and 8 ft high with a capacity of 1,000 bu. The other was a rectangular bin 8 ft by 16 ft with walls 4 ft high and a framework to support a tarpaulin cover. This bin had a capacity of 800 bu.

Grain with a moisture content of 10 to 12 per cent was stored successfully for a 9-months period in these bins. The temperatures were higher in these bins than in the steel and wood bins, however.

**Cement Plaster Bins.** Cement plaster bins have practical application for grain storage in the South Texas area because of the wide usage of this type of construction for cisterns. These bins are economical to build and show promise as ideal grain-storage structures for that area. The tight construction of these storages is particularly suited for effective insect control.

One of these bins was constructed at the Beeville Station in 1950. It was not completed in time to use for the 1950-51 tests, but will be used for the 1951-52 experiments.

**Underground Storages.** Underground storage has a definite place in the South Texas area. However, storages of this type are not practical except in pervious soil where the maximum water table is well below the storage area. These conditions exist in not over 10 per cent of the grain-producing area of South Texas.

In the immediate vicinity of the experiment station at Beeville conditions are well suited for underground storage. Tests conducted with this type of storage showed that grain can be successfully stored in trench silos.

Six 50-bu-capacity pits and one trench silo with a capacity of 500 bu were used for the experiments. One of the small pits was unlined, two were lined with concrete, one with roll roofing, one with reinforced paper and one with cement plaster. Wood-frame construction was used for the floor and walls of the larger pit. The pits were sealed by mounding the grain slightly and covering with roll roofing or galvanized corrugated roofing and 8 to 10 in of soil.

The unlined pit was not a satisfactory storage and the reinforced paper lining deteriorated after a few months storage. The other materials used for lining the pits gave satisfactory results, however. It is almost impossible to prevent soil from mixing with the grain, both during the loading and

unloading operation. From this standpoint, underground storages are not desirable for storing grain for commercial purposes. Even when grain is stored for feeding on the farm, the expense involved in constructing bulkheads to hold the grain and in protecting it during the feeding-out period amount to as much, if not more, than above-ground storages.

#### SUMMARY

Results of storage tests in South Texas during the past two years indicate that the moisture content and the amount of foreign material (trash) in sorghum grain are the primary factors to consider for safe storage. High moisture conditions and excessive trash lead to insect, mold and heat damage and, therefore, appear to be the basis for most of the problems encountered in storing the grain.

A moisture content above 12 per cent appears too high for safe storage. However, these tests show that excessive trash, which is usually higher in moisture content than the grain, will cause the grain to heat even though the moisture content is below 12 per cent. Proper adjustment of combines to deliver clean grain at harvest seems to be the practical remedy for this problem.

The moisture content of the grain can be successfully reduced to a safe storage level with batch-type column driers, bin driers or trailers equipped with false floors.

Insects can be most effectively controlled when the moisture content of the grain is below 12 per cent. Reducing the moisture content to this level will not completely eliminate the insect problem, but will usually reduce the number of treatments required to control the insects.

The heating of the grain during storage, insect damage and mold development appear to be the primary causes for reduction in germination. These factors emphasize the importance of storing clean seed with a moisture content below 12 per cent and then making every effort to prevent insect damage during storage.

Bins constructed of wood or steel, underground trenches and temporary structures are satisfactory for storing sorghum grain. Underground storage is not practical, however, except in well-drained areas where the maximum water table is well below the storage area.

#### "Simplifying Poultry Ventilation with Mathematics"

TO THE EDITOR

THE paper by Myron G. Cropsy which appeared under the above title in the December, 1951, issue of AGRICULTURAL ENGINEERING, contains two errors, one of which is perhaps obscure, but not the other.

An approximate formula for the relative humidity inside a poultry house as a function of the number of air changes per hour was developed correctly. As the problem was to ascertain whether ventilation would keep the litter dry, Cropsy assumed adverse external conditions and sought the minimum relative humidity. The function was not attractive for differentiation, but Cropsy was able to pick out (presumably by inspection) a factor of the derivative. This he equated to zero in the approved manner and solved for the number of air changes per hour, arriving at  $N = -MC/0.01914$ . Inserting values for  $M$  and  $C$ , the minimum for  $N = 0.1$  is near  $N = 2.86$  in absolute value, the value which Cropsy gave on his graph of the function being 2.4.

The curious error is that, though the main relationship was correctly derived, the negative sign in the solution for the location of the minimum was ignored. Naturally the sign has its usual significance, and the function has an extremum near  $N = -2.86$  which happens to be a minimum.

The more obscure error is now revealed. The factor of the derivative which Cropsy selected happens to be quite inappropriate to his problem. Investigation of the whole function shows the true situation. The minimum for positive values of  $N$  is near  $N = 3.28$ . This probably explains away Cropsy's concluding statement: "Due to other factors in the differentiated formula for relative humidity, the answer given by formula [7] is slightly on the side of less ventilation. Usually this amount is small." In addition, there are maxima near  $-1.82$  and  $-6.81$  and the minimum (found by Cropsy) near  $-2.86$ . For positive values of  $N$ , the minima for  $F = 0.05, 0.1, 0.2$  and  $0.4$ , (the values in Cropsy's graphs are, respectively, near 1.59, 3.28, 7.66 and 16.94).

HORACE W. NORTON

Professor of agricultural statistics  
University of Illinois, Urbana

## (Proposed ASAE Standard)

# Baling Wire for Automatic Balers

(NOTE TO ASAE MEMBERS: This proposed ASAE Standard was prepared and duly accepted by responsible representatives of the manufacturers of automatic hay balers and of annealed baling wire; it has been recommended for adoption as an ASAE Standard by the Steering Committee of the Power and Machinery Division, and unless substantial objection thereto is raised within 30 days, it will be declared an official ASAE Standard by the Council of the Society.)

### 1 SCOPE AND DESIGNATION

- (a) This specification shall cover annealed baling wire for automatic balers.
- (b) The wire shall be furnished in two sizes of coils: 3150 ft (approximately) and 6500 ft (approximately).

### 2 STANDARD PRACTICE

Unless otherwise specified, standard practices as covered in the latest revision of the AISI Steel Products Manual, Section 16, on carbon steel wire shall govern on all points covered by this specification.

### 3 REQUIREMENTS

#### (a) Physical Properties:

- 50,000 to 70,000 psi tensile strength
- 12 per cent minimum permanent elongation in 10-in length

#### (b) Rewinding Practices:

Wire shall be wound with a uniform tension and shall be furnished with an oil-base protective coating that will not harden or produce a gummy condition in the baler tying mechanism.

Wire shall be free from injurious heavy scale and surface imperfections

Wire shall be free of kinks and shall be of continuous length; therefore, it shall contain no twisted splices. Welded joints shall be dressed down to wire diameter

Wire shall uncoil from inside or outside of coil

Outside end of wire shall bear a tag containing only the manufacturer's identification; inside end of coil shall be bent over the tie wire at the inside diameter.

#### (c) Dimensions:

Wire shall be furnished in rewind coils, conforming to the following requirements:

Description	3150-ft coil	6500-ft coil
Wire gage no.	14½	14½
Wire diameter	0.076 in ± 0.002 in	0.076 in ± 0.002 in
Inside diameter	5 in ± ½ in	8½ in ± ¼ in - ¾ in
Outside diameter	9½ in ± 0, - ½ in	13¾ in ± ¼ in
Coil width	8¾ in ± 0, - ½ in	6 in ± ¼, - 0 in
Length	3150 ft ± 1%	6500 ft ± 1%

### 4 PACKAGING

Coils shall be banded securely with six ties on the 6500-ft coil and four ties on the 3150-ft coil, evenly spaced.

(NOTE: If wire is used as a tie, a minimum of 15 gage shall be used.)

Coils of wire shall be shipped in suitable containers providing adequate protection for shipping, storage and distribution.

The 3150-ft coil shall be shipped two in a carton which shall be marked as follows:

Package No. 3150

ASAE Standard Baling Wire (2 coils), 14½ gage

Approximately 3150 ft per coil

The container shall also carry, in a different location, the name and/or brand name of the wire manufacturer, and necessary instructions for storing and handling.

The 6500-ft coil shall be shipped one in a carton which shall be marked as follows:

Package No. 6500

ASAE Standard Baling Wire (1 coil), 14½ gage

Approximately 6500 ft

The container shall also carry, in a different location, the name and/or brand name of the wire manufacturer, and necessary instructions for storing and handling.

### 5 INSPECTION AND REJECTION

Any coil not conforming to the foregoing specifications may be rejected and the manufacturer or distributor notified.

### 6 BALERS IN THE FIELD

An interim coil conforming to the following specifications shall be made available for use with balers in the field at the time of adoption of this standard, as long as there is sufficient demand to justify production.

Wire gage number	14½
Wire diameter	0.076 in ± 0.002 in
Inside diameter	12 in ± 0, - 1 in
Outside diameter	18 in ± ½ in
Coil width	3½ in ± 0, - ¼ in
Length	Approx. 6500 ft ± 1%

This coil shall be shipped in a carton which shall be marked as follows:

Baling Wire, 18-in diameter coil, 14½ gage

Approximately 6500 ft

For balers requiring 18-in diameter coil

Container shall also carry, in a different location, the name and/or brand name of the wire manufacturer, and necessary instructions for storing and handling.

### 7 EFFECTIVE DATE

The ASAE standard baling-wire coil shall be available on or before October 1, 1952.

## RESEARCH NOTES

ASAE members and friends are invited to supply, for publication under this heading, brief news notes and reports on research activities of special agricultural engineering interest, whether of federal or state agencies or of manufacturing and service organizations. This may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Mich.

### USDA Notes on Standby Electric Generators, Fork-Lift Trucks to Handle Fruit, Weed Control Progress, Fiber Flax Deseeder

**Standby Electric Generators.** Farmers who need or desire electricity, when normal power service to the farm is interrupted, should install a standby electric generator that can generate at least 3,000 w. Agricultural engineers of the U.S. Department of Agriculture and the North Dakota Agricultural College, who during the past year surveyed 97 farmers owning standby generators in the Red River Valley of North Dakota and Minnesota, consider 3,000 w. the minimum power necessary to operate a milking machine, furnace, freezer, water system, and a normal number of lamps.

The most economical type of generator is that operated by a tractor, as it eliminates the need of a separate gasoline engine to power the generator.

The North Dakota survey showed that 78 of the 97 owners of standby electric generators had made use of them at least once during the past year. Time of use varied from 1 to 480 hr. The average for the year was slightly more than 42 hr.

Although the need for such standby power to fill in during storm-caused electric outages may be greater in the northern states, such equipment can provide good insurance for any farmer whose enterprises depend on the continuous operation of electric equipment—chick and pig brooders, and refrigerated storages, for example.

More than half of the farm families interviewed listed operation of their automatic furnace for home heating as the main reason for having standby electric power. Electrically driven water systems and milking machines also were primary reasons listed by many of the owners.

The engineers found many of the installations fitted with improper switches and fuses, which created hazards to the equipment, the farmer, and in some cases, to the linemen whose job it was to maintain the normal power lines leading into the farm. A double-throw switch which allows use of either high-line or standby generator power—but not both—at one time, is essential for a safe installation. The engineers also recommended dual-voltage installations, which can furnish power at 115 and 230 v. Single-voltage installations (110-120 v) do not provide voltage to operate much of the important electrical equipment now being used on farms.

**Fork-Lift Trucks in Handling Fruit.** Fork-lift trucks can save many fruit growers, packers, and processors a great deal of hand labor, according to a cooperative study made by U.S. Department of Agriculture and Michigan State College engineers during the 1951 harvest season. The study indicated that any grower raising 100 or more tons of cherries, 10,000 or more bushels of peaches, pears, or apples, or any combination of these fruits totaling 10,000 or more crates can increase his net returns by using lift trucks.

Handling a 25,000-bu apple crop from orchard to storage or truck without lift trucks in 1950 required two tractors, four orchard trailers, and seven husky men. However, in handling essentially the same crop in 1951, but employing a lift truck, only two tractors, two orchard trailers, and three men were required. The savings in dollars and cents on the unloading and loading operations alone amounted to \$1,000 during the harvest season.

The fork-lift trucks proved useful not only in loading and unloading fruit, but also for moving fruit to and from graders, into and out of storage, and for transporting fertilizer, spray materials, and other heavy equipment from place to place. As an example, one man with a lift truck can move and stack in storage up to 5,000 bu of fruit a day. One fruit grower, who grades his fruit, eliminated the services of two men by using a lift truck in his operation. The lift truck also permits growers to make better use of their own or hired trucks, because quicker and easier loading with the lift allows more trips a day, resulting in two trucks doing the work of three.

The engineers found that placing crated fruit on pallets in the orchard, and then using lift trucks to stack and transport the pallets not only speeded up the processing and packing of fruit both on and off the farm, but also reduced spilling and bruising of the fruit.

**Progress in Weed Control.** Progress in weed control methods and equipment, emphasized in recent research reports of agricultural engineers of U.S. Department of Agriculture, included these developments:

In cooperative studies with the Iowa Agricultural Experiment Station, the engineers studied methods of controlling weeds when crops were planted on the ridges, rather than in the furrows of listed fields. Although ridge planting results in better water and soil conservation, and probably increased yields, it has not been widely practiced because weed control has been too great a problem. However, in field trials with both corn and soybeans that were ridge-planted, the engineers were able to control weeds satisfactorily with a combination of herbicide spraying and mechanical cultivation.

In corn they applied two pounds of the ester form of 2,4-D per acre, shortly after planting and followed with cultivations when the corn was 15 and 24 in high. This combination gave excellent control of grassy and broadleaved weeds throughout the season.

Soybeans were planted in single rows and in triple rows 7 in apart on top of the ridge. Half were given a pre-emergence spraying with 2,4-D ester at the rate of 2 lb per acre, and the other half were sprayed with EH-1, a newer herbicide, at the rate of 4 lb per acre after the soybeans were above ground. These treatments plus one mechanical cultivation between ridges gave satisfactory weed control. The combination including pre-emergence spraying proved slightly better than the other.

Another cooperative investigation with Iowa has resulted in the development of a sound, basic design for a lower cost, effective, self-propelled, high-clearance sprayer. The engineers found that by grouping the sprayer parts on a framework between tandem wheels (arranged like those of a motorcycle) and relying on an outrigger wheel for stability, they had a sprayer that worked well on both steep hillsides and level ground. The tandem-wheel arrangement reduces the cost of construction as compared with the more elaborate, tricycle-type, high-clearance sprayers now in general use.

The corrosiveness of herbicides in sprayer parts is a weed control problem getting intensive study, in cooperation with the Minnesota Agricultural Experiment Station. USDA engineers reported that TCA, a prominent weed killing chemical, has proved severely corrosive to aluminum when in the presence of bronze, copper, or brass. On the other hand, the TCA does not appear to be corrosive when in contact with aluminum alone or with aluminum and steel. Also under test for corrosion are copper, brass, bronze, natural rubber, neoprene synthetic rubber, and vinylite plastic.

**Fiber Flax Deseeder.** The recent development of an improved fiber-flax deseeder through the cooperative research of agricultural engineers of the U.S. Department of Agriculture and the Oregon Agricultural Experiment Station, is discussed in detail in USDA Circular 890, "Deseeding of Fiber Flax."

Like other mechanical developments resulting from this research, the deseeder is helping the fiber-flax industry in this country compete on a favorable basis with that of other nations which depend on cheap labor, using old methods. A flax puller or harvester, a bulk straw unloader, and a scutcher—a machine that separates the flax fibers from the straw—are other useful contributions stemming from the research.

The improved deseeder, which has been used in a commercial plant to process more than 1,000 tons of straw, has proved nearly four times more efficient than any other machine now in use. It handles a ton of straw with 1.8 man-hours of labor, while its nearest competitor, a foreign machine, requires 7 man-hours of labor per ton.

A five-man crew operating the improved deseeder can process more than three tons of flax straw an hour. As it passes through the machine, the straw is deseeded, straightened, and automatically tied into neat, uniform bundles. In this way, the machine reduces labor required in subsequent operations and supplies a more uniform fiber, better suited to the spinner's needs. A free copy of Circular 890 may be obtained from the Office of Information, U.S. Department of Agriculture, Washington 25, D.C.

## NEW BULLETINS

**Cement and Concrete Reference Book, 1951.** Portland Cement Association (33 West Grand Ave., Chicago 10, Ill.). This 112 page booklet has been specially prepared as a reference work for editors, to help them deal effectively and factually with news and features on developments in which applications of cement and concrete are of public interest. It provides condensed information on the portland cement industry, the nature of portland cement concrete, and the Association; and on applications in paving, structures, housing, farming, and conservation. Brief information is also given on precast concrete products, special uses of cement, and cement and concrete in national defense.

**Comparative Performance of Side-Opening and Immersion Type Milk Coolers.** by John E. Nicholas, J. F. Cone, and G. H. Watrous, Jr. Progress Report No. 59 (November 1951), The Pennsylvania State College (State College, Pa.). This report on a series of tests indicates generally comparable results with the two types of coolers in preventing bacterial growth, and in time, temperature and current factors.

## NEWS SECTION

### ASAE Officers for 1952-53

**A**S THE result of the regular election of officers of the American Society of Agricultural Engineers conducted by letter ballot of the corporate members of the Society during February and March, the following officers have been elected and will take office at the close of the Society's annual meeting to be held in Kansas City, Mo., June 16 to 18.

**President**—Ivan D. Wood, irrigation engineer, research division, Soil Conservation Service, U.S. Department of Agriculture, Room 202, Old Customs House, Denver 2, Colo.

**Vice President** (3-year term)—Lawrence H. Skomme, chief engineer, New Holland Machine Div., The Sperry Corp., New Holland, Pa.

**Counselor** (3-year term)—Herbert N. Stapleton, head, agricultural engineering department, University of Massachusetts, Amherst.

**Nominating Committee**—Frank J. Zink (chairman), consulting engineer, Frank J. Zink Associates, 4900 Board of Trade Bldg., Chicago 4, Ill.; Fred R. Jones, head, agricultural engineering department, A & M College of Texas, College Station, Tex.; and Hobart Berestford, head, agricultural engineering department, Iowa State College, Ames, Iowa.

The members of the Council for the Society year 1952-53 will include the above-named newly elected officers together with the following: F. C. Fenton and Stanley Mahill, past-presidents; E. I. Hansen, vice-president; and R. C. Hay, W. D. Henker, and Howard Matson, counselors.

Members of the Society are invited to send any member of the Nominating Committee such suggestions as they may have for nominees for election of officers for the Society in the next annual election of officers which will be held in February and March, 1953. It is desirable that such suggestions reach the Nominating Committee on or before June 1, 1952.

### ASAE North Carolina Section Organized

**A**PPROXIMATELY 50 agricultural engineers resident of North Carolina met on Saturday, February 23, on the campus of North Carolina State College at Raleigh, to organize the North Carolina Section of the American Society of Agricultural Engineers, the Council of the Society having previously approved a petition of ASAE members in the state requesting authorization to organize as a state section.

Norman C. Teter, associate agricultural engineer, North Carolina State College, acted as temporary chairman of the meeting. The principal order of business of the meeting was the election of the regular officers of the Section, and the following ASAE members were elected to serve for the coming year.

**Chairman**, John W. Weaver, Jr., research professor of agricultural engineering, North Carolina Agricultural Experiment Station, Raleigh.

**First vice chairman**, J. M. Wagner, president and general manager, Turner Mfg. Co., Statesville.

**Second vice chairman**, Joseph N. Howard, agricultural engineer, Duke Power Co., Greensboro.

**Secretary-treasurer**, Jack W. Traywick, administrative assistant, division of test farms, North Carolina Department of Agriculture, Raleigh.

The meeting was devoted mainly to a discussion by members of procedure for organizing a state section and of the advantages which participation in section activities offered to Society members in the state.

The new section was honored to have at its organization meeting a past-president of ASAE, E. I. Brackett, formerly head of the agricultural engineering department, University of Nebraska, who spoke briefly at the section dinner served at the college cafeteria.

### Virginia Section Presents Interesting Program

**T**HE regular yearly meeting of the Virginia Section of the American Society of Agricultural Engineers was held this year at the Natural Bridge Hotel, Natural Bridge, Va., on April 4 and 5. The program of the meeting featured the following papers and speakers:

The use of preserved wood in farm buildings and farm fences by Ralph H. Main, engineer, service bureau, American Wood Preservers Assn.

Three-member joints for nailed trussed ratters by Paul W. Stoneburner, assistant agricultural engineer, Virginia Agricultural Experiment Station.

Infrared brooding by J. W. Hall, agricultural engineer, Appalachian Electric Power Co.

Resources development through community watersheds by Walter C. Gumbel.

### ASAE Meetings Calendar

April 4 and 5—VIRGINIA SECTION, Natural Bridge Hotel, Natural Bridge, Va.

April 10 and 11—PENNSYLVANIA SECTION, Agricultural Engineering Bldg., Pennsylvania State College, State College.

April 11 and 12—SOUTHWEST SECTION, Grim Hotel, Texarkana, Tex.

April 11 and May 9—WASHINGTON (D.C.) SECTION, Room 6062, South Bldg., USDA, Washington.

May 5—OHIO SECTION and MICHIGAN SECTION, Toledo Edison Club House, Maumee, Ohio.

MAY 9—MINNESOTA SECTION, University of Minnesota, University Farm, St. Paul.

May 16 and 17—ALABAMA SECTION, Gulf Breeze Inn, Gulf Shores, Ala.

June 16-18—15TH ANNUAL MEETING, Hotel Muehlebach, Kansas City, Mo.

August 25-27—NORTH ATLANTIC SECTION, University of Maine campus, Orono.

October 30-November 1—PACIFIC NORTHWEST SECTION, Oregon State College, Corvallis.

December 15-17—WINTER MEETING, Edgewater Beach Hotel, Chicago, Ill.

**Note:** Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Michigan.

The role of power farming in national defense by E. A. Wirt, advertising manager, J. I. Case Co.

Report on corn drier field study by C. G. Chambliss, assistant agricultural engineer, Virginia Agricultural Experiment Station.

Development of the Roanoke River basin by Col. William F. Powers, district engineer, Norfolk Division, Corps of Army Engineers.

Depth and spacing of drain laterals as computed from core sample permeability measurements by Phelps Walker, associate agricultural engineer, Soil Conservation Service, U.S. Department of Agriculture.

The program committee arranging this program included the Section officers as follows: Chairman, J. A. Waller, Jr., associate agricultural engineer, Virginia Agricultural Extension Service; vice-chairman, M. M. Johns, manager farm supply service, Southern States Cooperative, Inc.; J. L. Calhoun, associate agricultural engineer, Virginia Agricultural Extension Service; and U. F. Earg, associate professor of agricultural engineering, Virginia Polytechnic Institute, and secretary-treasurer, McNeil Marshall, associate agricultural engineer, Virginia Agricultural Experiment Station.

The new Section officers elected at this meeting for the ensuing year, will be announced in the May issue of AGRICULTURAL ENGINEERING.

(News continued on page 226)

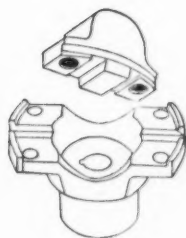


Officers of the newly organized North Carolina Section of ASAE plus an ASAE past-president. Left to right: J. M. Wagner, first vice-chairman; J. W. Traywick, secretary; J. W. Weaver, Jr., chairman; E. I. Brackett, past-president of ASAE; and J. N. Howard, second vice-chairman.

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## NEWS SECTION (Continued from page 224)

## Frank Lanham Now at ASAE Headquarters

FRANK B. LANHAM, who as announced in AGRICULTURAL ENGINEERING for January was appointed Assistant Secretary of ASAE by the Council of the Society at its meeting last December, took up his new duties at the headquarters office of the Society at St. Joseph, Michigan, at the beginning of this month.

For the past two years Mr. Lanham has been enrolled as an industrial fellow in the agricultural engineering department at Iowa State College, where he has been pursuing graduate work leading to the degree of doctor of philosophy in agricultural engineering. He has now completed requirements for the degree which the College awarded to him last month.

Mr. Lanham brings to the ASAE headquarters organization excellent training and a fine background of experience which ably equip him for his new work for the Society and the profession which it represents.

## C. W. Smith New Chairman Mid-Central Section

CHAUNCEY W. SMITH, professor of agricultural engineering, University of Nebraska, Lincoln, was elected the new chairman of the Mid-Central Section of the American Society of Agricultural Engineers at its yearly meeting held at the Town House Hotel in Kansas City, Kans., on March 8.

The three new vice-chairmen of the Section elected at the meeting are Harold E. Stover, extension agricultural engineer, Kansas State College, Manhattan, Omar H. Day, engineer in charge of product research and development, Butler Mfg. Co., Kansas City, Mo., and Harry F. Burton, rural supervisor, St. Joseph Power and Light Co., St. Joseph, Mo. Robert P. Beasley, agricultural engineering department, University of Missouri, Columbia, was elected the new secretary of the Section.

The program for the forenoon consisted mainly of a symposium on the Kansas flood of 1951. The subject of storm intensities and patterns was presented by Vern Alexander of the U.S. Weather Bureau at Kansas City. Henry Beckman, regional engineer of the U.S. Geological Survey discussed surface runoff from the basins. SCS watershed programs in relation to 1951 flood damage was presented by a substitute speaker for Kirk Sandall, chief of the water conservation division in Region 5, SCS, and Col. E. J. Lincoln of the U.S. Army Engineers in the Kansas City district presented a future program based on recent flood flows. Motion pictures of the Kansas flood of 1951 were presented through the courtesy of the Corps of Engineers of the U.S. Army. The concluding number on the program of the forenoon session was a paper on making machines and terrace systems more compatible, presented by J. F. Schunk, University of Nebraska.

The afternoon program was opened by ASAE President Stanley Madill, executive engineer, John Deere Waterloo Tractor Works, in an inspiring address on the growth that is being made in the agricultural engineering profession.

Mr. Madill's address was followed by a panel discussion on the harvesting and drying of high moisture corn, wheat and legumes. M. F. Arms, University of Nebraska and G. E. Fairbanks, Kansas State College, discussed the subject of harvesting. F. C. Fenton, Kansas State College, G. M. Peterson, University of Nebraska, and D. B. Brooker, University of Missouri, talked on developments in drying research, and J. G. Andros of Butler Mfg. Co. talked on new equipment.

The program was concluded with a report by Paul N. Doll, chairman of the local arrangements committee for the 1952 ASAE Annual Meeting to be held in Kansas City, June 16 to 18, on plans in progress for entertaining the national society with the Mid-Central Section as the host.

## Pennsylvania Section Program

THE Pennsylvania Section of the American Society of Agricultural Engineers has arranged an interesting program for its spring meeting on the campus of Pennsylvania State College, April 10 and 11, which includes the following subjects and speakers.

Research in agricultural engineering at Penn State will be reviewed by A. W. Clyde, J. E. Nicholas and A. S. Mowery of the college's staff. Methods and problems in pasture renovation will be discussed by Edward A. Silver, New Holland Machine Division of the Sperry Corp. J. B. Washko of Penn State will talk on seeding and fertilizing of pastures, and R. B. Alderfer, also of Penn State, will speak on irrigation of pastures. Two other papers on irrigation include one on vegetable crop irrigation by M. L. Olland and another on irrigation water rights by F. H. Cook, both of Penn State. R. J. Hamilton, Hamilton Equipment Co., will talk on irrigation equipment.

The Section dinner on the evening of April 10 will be addressed by Dr. Kenneth Hood, head, agricultural economics extension unit, Pennsylvania State College.

The program on April 11 will be opened with a talk on chopping vs.

balancing of forage crops by Herbert Muffley, a Pennsylvania farmer, which will be followed by a talk on new barns at Penn State by M. L. Dawdy of Penn State. The use of glass pipe for conveying milk will be discussed by I. E. Parkin, G. L. Bressler will report on poultry house research, and A. S. Mowery will talk on automatic equipment in the new college poultry house—all three speakers members of the Penn State faculty.

The Section business meeting, including the election of officers will be held at the opening session of the afternoon of April 11, which will be followed by tours of the new college barns and poultry houses.

## Iowa-Illinois Section Program

TWO outstanding program numbers featured the meeting of the Iowa-Illinois Section of the American Society of Agricultural Engineers held at the Short Hills Country Club in East Moline, Ill., on March 7.

New Trends of Bolted Assemblies was the subject of an interesting technical paper by J. S. Davies, assistant general sales manager, Russell, Burdett and Ward Bolt and Nut Co.

The question "How Will the Ever-Changing Labor-Food Production Ratio on American Farms Affect the Farm Equipment Industry?" was ably and interestingly handled by C. L. Oheim, vice-president of Deere and Co.

## Southwest Section Meets at Texarkana

THE next regular yearly meeting of the Southwest Section of the American Society of Agricultural Engineers will be held at the Grim Hotel, Texarkana, Tex., April 11 and 12. The following papers of particular interest to agricultural engineers are scheduled for presentation and discussion at this meeting.

Rice storage and conditioning by Xzin McNeal, University of Arkansas, serving the farmer with electric power by Homer M. Gibbs, Texas Power and Light Co., mechanization of castor bean production by E. D. Baker, Oklahoma A. & M. College, the development of graphic aids for spraying by James E. Garton, Oklahoma A. & M. College, the use of elastic pipe by W. B. Struble, Texas Pump and Supply Co., farm electrification for so-called teachers by John H. Hough, Louisiana State University, hydraulic studies of conservation structures by W. O. Ree, U.S. Soil Conservation Service, supervision and inspection of construction of small earth dams for flood control by J. G. Hill, Jr., U.S. Soil Conservation Service, and ground water uses and recharge possibilities in the Grand Prairie Region of Arkansas by Kyle Engler, University of Arkansas.

At the section dinner on the evening of April 11, the featured speaker will be Stanley Madill, president of ASAE, and executive engineer, John Deere Waterloo Tractor Works of Deere Manufacturing Co.

## Ohio Section Celebrates First Anniversary

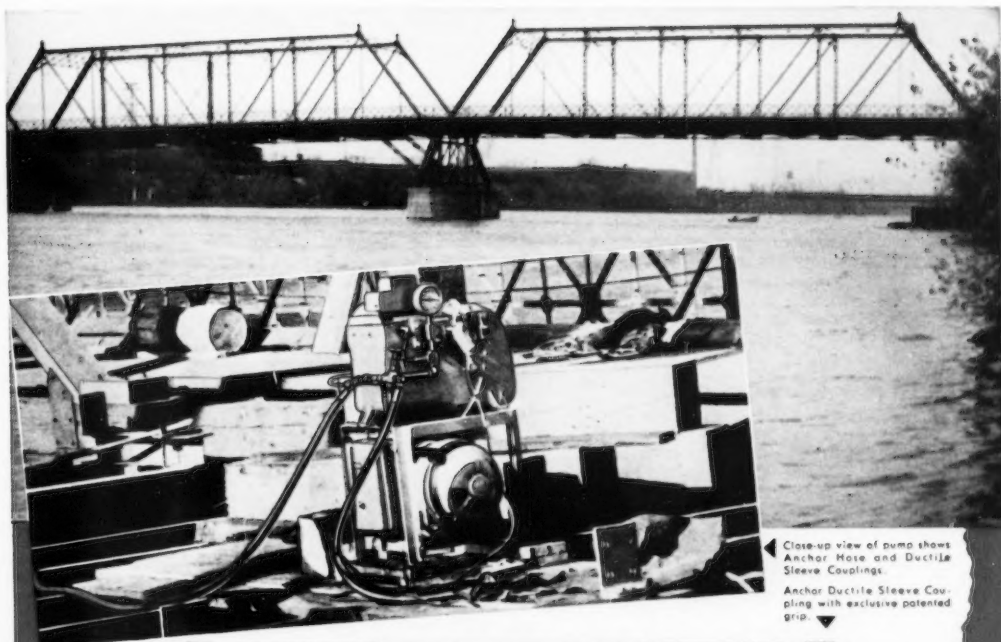
THE meeting of the Ohio Section of the American Society of Agricultural Engineers held March 8 on the campus of the Ohio State University marked its first anniversary as an authorized state section of the Society. About 60 members and friends of the Section were in attendance.

The forenoon program featured a panel discussion on the responsibility, capability, and organization for agricultural research. The panel included Dr. W. F. Krauss, associate director, Ohio Agricultural Experiment Station, Dr. K. S. Chester, supervisor of agricultural research, Battelle Memorial Institute, R. J. Miller, manager of research and engineering, Dearborn Motors Corp., and B. C. Boulton, chief production and design engineer, New Idea Div., Avco Mfg. Corp. The discussions emphasized that not enough research is basic and that more manufacturing organizations might well devote more attention to research. At the present time only about seven per cent of the research conducted by state and federal agencies is basic research, and in agriculture as a whole only about one-half of one per cent of the gross business volume is being spent for research. It was further pointed out that the soundness of a larger investment in research has been well demonstrated by the chemical industry which has invested two to three per cent of its gross income in research with phenomenal results.

Following luncheon, the group was entertained by an excellent illustrated talk by R. D. Barden, agricultural engineering staff, Ohio State University, on a fishing trip to Georgian Bay.

The afternoon program featured progress of research participated in jointly by the agricultural engineering department of the Ohio State University and the Ohio Agricultural Experiment Station. Following a resume of important research findings of recent years by G. W. McCuen, Truman Goins reported on the drainage project dealing with depth and spacing of tile. J. D. Hummel gave an interesting demonstration on the work with alcohol-water injection for internal-combustion engines to increase the octane rating of regular gasoline. H. T. Hurst described a proposed farm building research program including a cooperative project on the utilization and preservation of native timber. W. H. Johnson

(Continued on page 228)



## *Bridge lifting job handled easily—* with high-pressure **ANCHOR** hose and ductile sleeve couplings

MINNEAPOLIS . . . Here's a difficult job recently performed on the Broadway Avenue Bridge. Four spans across the upper Mississippi, each weighing approximately 250 tons, were raised to provide 19 ft. additional clearance at one side of the river for the passage of boats and sloped to the existing level on the other side. Anchor Hose and Ductile Sleeve Couplings, well-known for dependability and safety, were used for transmitting the required high hydraulic pressures to the twenty 4" jacks under each span. The use of hydraulic hose and the principle of hydraulic lifting made it possible to do this unusual job.

Tough jobs like this point up the superiority of Anchor factory-assembled couplings and hose. The

positive seal eliminates leakage even under extreme pressures. The exclusive, patented Anchor grip makes the coupling virtually a part of the steel reinforcing wire of the hose — prevents blow-offs.

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DUST  
HAS SETTLED...**

During the past fifty-five years we have watched many ambitious and enterprising manufacturers endeavor to copy the very extensive Oberdorfer line of bronze rotary gear pumps or present the world with their substitute.

It was not our business to notify these gentlemen that it would be financial suicide to try to duplicate the combination of quality and price so long associated with the name of Oberdorfer thruout the world. History is amply littered with the evidence.

There are available today many spray pumps more intricately designed, more delicately constructed and more costly to purchase and operate in the field.

Why gild the lily! Demand an inexpensive, trouble free corrosive resistant bronze gear pump that accurately meters your spray formulations, positively, efficiently and at lowest cost per acre.

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Agricultural Pump Div., Oberdorfer Foundries, Inc.  
1424 Thompson Rd., Syracuse, N. Y.

**BRONZE OBERDORFER  
SPRAYING PUMPS**

## NEWS SECTION (Continued from page 226)

reported on experimental work being conducted in corn and grain drying, tillage, and weed control, and George S. Sanders explained the aviation project in which an attempt is being made to develop standards and tests for evaluating spraying, seeding, and fertilizing by airplane.

The program was concluded by presentation of a student research project, by C. W. Schoup, in which a study is being made of the development of a power-driven grain and silage unloader cart. Mr. Schoup, a senior student, was assisted by K. V. Battles and D. M. Byg.

The Ohio Section will meet jointly with the Michigan Section on May 5 at the club house of the Toledo Edison Co. at Maumee, Ohio.

### Report from India

ACCORDING to word from Earle K. Rambo, extension agricultural engineering adviser to the Government of India, the newly organized Indian Institute of Technology, a government institution located at Hili (Kharagpur) about 70 miles west of Calcutta, is planning to offer a professional course in agricultural engineering leading to a degree, and also after two or three years, to offer graduate work in agricultural engineering. It appears that Mr. Rambo served on the committee that prepared the recommendations for inaugurating this course and also assisted in setting up the proposed curriculum for the four-year course in agricultural engineering.

This technological institute, which is being organized by the Central Government of India, will set a high standard for the country similar to that set by the Massachusetts Institute of Technology in the engineering field in the United States.

### Conservation of Grain Discussed at Washington Section Meeting

THE conservation of grain from farm to consumer was the subject of A. F. Troyer, deputy director, grain branch, Production and Marketing Administration, USDA, in his address before members of the Washington Section of the American Society of Agricultural Engineers at its luncheon meeting on March 14.

Mr. Troyer pointed out that 25 years hence it will be necessary to produce enough food to feed one more person at every table of the present four. The population in this country is increasing at the rate of 7,000 persons daily. In the past it has been possible to meet increased national food requirements by bringing more land into production, introducing farm mechanization, fertilization, and improved varieties of crops. As to what can be done from now on to meet the increasing food demands, Mr. Troyer pointed out that it will be necessary to produce bigger harvests on the land of our farms and to save more of the crops grown. Oftentimes as much as 25 per cent of the crop grown is lost. An additional one billion bushels of storage facilities are required to properly store farm crops and provide the necessary carry-over. More storage space is also required on the farm. The services of agricultural engineers are needed to develop and apply the necessary ventilation, drying and other equipment to maintain the quality of the stored crops. An unusually lively discussion followed Mr. Troyer's talk.

Joseph H. Broome, vice-chairman of the Section, who presided at the meeting, reported that the Washington Section was voted into membership of the District of Columbia Council of Engineering and Architectural Societies at their meeting on March 7. At the request of the Council two delegates and two alternates will be chosen to represent the Washington Section at regular meetings of the Council.

### Ag Engineering Program at ASEE Meeting

A SPECIAL luncheon and conference to feature the subject of agricultural engineering is being arranged in connection with the next annual meeting of the American Society for Engineering Education to be held at Hanover, N. H., the last week in June. The theme of the conference program will be the effect of current mechanization of agriculture on curriculum requirements and administration of agricultural engineering departments. The program which will immediately follow the luncheon will include the following addresses:

"Integrating the Activities of an Agricultural Engineering Department in a School of Engineering"—George A. Marston, dean of engineering, University of Massachusetts

"Effects of Recent Research on Curriculum Requirements in Agricultural Engineering"—E. G. McKibben, director of agricultural engineering research, U. S. Department of Agriculture

"Manpower and the Job, in Engineering Service for the Agricultural Industry"—I. M. K. Boelter, dean of engineering, University of California (Los Angeles)

Another feature of the conference will be a display being arranged by J. Dewey Long, associate director of agricultural engineering research, USDA, showing production, manpower, the use of power and machinery, investment per worker and other facts which show the relationship of agricultural engineering to the agricultural industry.

(Continued on page 230)

# Why "total engineering" of screw conveyors means better performance for your machines

**LINK-BELT conveyor screws and components are engineered to give you the right screw conveyor for your particular needs**

THERE are many important factors in conveyor screw construction that must be correlated to give you top screw conveyor efficiency. That's why Link-Belt's "total engineering" is so vital to you . . . why Link-Belt conveyor screws are first choice of so many leading designers.

Consider Link-Belt's broad experience in building conveyor screws for every type of farm machinery. And, remember, Link-Belt makes all types and sizes of components—can give you the ones that exactly match your requirements.

For any auger or screw conveyor applications on your farm machinery, call the Link-Belt office near you for complete information.



Link-Belt Screw Conveyor and Roller Bearings help give the Portable Feed Mill, manufactured by The N. P. Bowsher Co., South Bend, Ind., high capacity with low power requirements.

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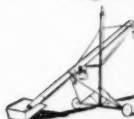
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**Grain loaders**



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**Post hole diggers**



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That's the experience of the IOWA MFG. CO. manufacturers of this super-tandem crushing plant which employs a 14" STOW power drive shaft, operating at 800 RPM. A centrifugal clutch relieves sudden starting loads. Use of the flexible shaft as shown permits a swing of up to 90 degrees either side of the center line.

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## NEWS SECTION (Continued from page 228)

### An Engineer Moves Up

ROBERT P. MESSENGER, who has been serving as an executive vice-president of the International Harvester Co., giving executive direction to foreign operations, has recently relinquished his direct relationship to foreign operations, to assume the executive direction of the Company's manufacturing, engineering, steel, and fiber and twine operations. Mr. Messenger's long experience, both in the United States and in other countries, having to do with manufacturing and engineering, has given him excellent preparation to assume the top-level direction of these important operations of the Company's business. His early experience with the Company was as an engineer, and later he obtained wide experience in manufacturing in several plants in the United States and later in the Company's works in Europe. As chief executive officer of the company's Australian subsidiary, he was in charge of the design and construction of Geelong Works in that country. In his subsequent direction of foreign operations, he participated in engineering and manufacturing problems of wide scope.

### FEI Industry-Research Conference at MSC

THE agricultural engineering department of Michigan State College at East Lansing will be host to the next Farm Equipment Institute Industry-Research Conference which will be held on the MSC campus on May 12 to 14. All who are interested in the Conference program are invited to attend.

The Conference will be opened on May 12 by A. W. Farrall, head of the MSC agricultural engineering department, and following a welcome by E. L. Anthony, MSC dean of agriculture, and a statement of the objectives of the Conference by Frank P. Hanson, chairman of the FEI Research Committee, an address on agriculture in a changing world will be made by Thomas H. Cowden, head of the MSC agricultural economics department. This will be followed by an address on agricultural research by C. M. Hardin, director, Michigan Agricultural Experiment Station.

The afternoon program of the first day will be devoted to a panel discussion on grassland farming featuring five speakers of the MSC school of agriculture—R. W. Bell, farm crops extension; E. M. Elwood, agricultural economics; S. T. Dexter, farm crops; and R. G. White and D. E. Wiant, agricultural engineering. Following the program there will be a tour of the agricultural engineering laboratory. A special dinner is being arranged for the group at the Kellogg Center, following which there will be an address by Dr. John A. Hannah, president of MSC, on foreign and problems and opportunities.

The forenoon program of May 13 will open with a symposium on pest control, the featured speakers will be Frank Irons, USDA Pest Control Laboratory; V. H. Griesby, MSC professor of botany; Keith Barrons, Dow Chemical Co.; and W. M. Carleton, MSC professor of agricultural engineering. Other speakers on the program include F. W. Duffee, University of Wisconsin, on the windrow-forage harvester methods for harvesting small grains; Truman E. Henton, USDA farm electrification division, on research in rural electrification; and C. L. Hamilton, National Safety Council, on farm safety problems.

The afternoon program will feature a symposium on the animal industries, including a discussion of trends in those industries by R. H. Nelson, Earl Weaver, and C. G. Card, respectively heads of the MSC animal husbandry, dairy, and poultry departments. The subject of nutrition will be discussed by C. F. Huffman, MSC dairy department, and B. E. Cargill, agricultural engineering department, will talk on labor-saving methods in handling dairy cattle. Following the program there will be a tour of the campus and a visit to the pen barn research and demonstration center.

The first part of the program for the forenoon of May 14 will be a symposium on soil and tillage problems, with all speakers from the MSC school of agriculture. L. M. Turk, soils department, will discuss soil structure; R. L. Cook also of the soils department, and H. F. McColly of the agricultural engineering department, will discuss tillage methods, and J. F. Davis of the soils department will talk on fertilizer application. The subject of mulch tillage will be presented by I. D. Mayer, Purdue University extension agricultural engineer. Three other talks on the forenoon program will include the subject in trends in fruit and vegetable production by H. B. Tukey, horticulture department, supplemental irrigation, P. E. Schleusener, agricultural engineering department, and muckland farming, J. F. Davis, soils department.

At the closing session of the Conference on the afternoon of May 14, F. W. Duffee, University of Wisconsin, will discuss pasture renovation equipment and methods. This will be followed by a discussion of the subject of grain and forage conditioning by G. H. Foster, U.S. Department of Agriculture. E. G. McKibben, director of agricultural engineering research, USDA, will address the group on looking ahead in farm mechanization. The Conference will be summarized by Frank P. Hanson and Arthur W. Farrall.

All sessions of the Conference will be held at the new Kellogg Center on the Michigan State College campus, and all who plan to attend should make guest room reservations direct with the Kellogg Center, Michigan State College, East Lansing.

(Continued on page 232)



"Steel buildings are  
just the thing for cows"



says  
**Robert Schaller,**  
**Onalaska, Wis.**

**Mr. Schaller** wrote us a letter about his new steel-roofed dairy barn. Here's what he said:

"We put up a 42 x 144 steel barn in the fall of 1950 and it's completely satisfactory in every way.

"The barn was built to accommodate a 100 cow milking herd to be used for sleeping quarters only. At the present time we have about 65 head.

"Steel is good and strong so it makes an ideal roof framing material. Ours is all-welded construction. As you can see from the pictures, the entire roof span of 42 feet doesn't need a single support column. The cows can move around freely and you can drive anywhere you like with a manure loader or spreader.

"We get some bad storms around here but I'm sure that no matter how bad they are the roofing sheets will stay on good and tight. The sheets are strong and stiff and they don't work loose around the holes. A hole was drilled through each sheet into the steel roofing member, then the sheets were pulled down tight with self-tapping cap screws. There's a steel-lead washer under each screw. The steel furnishes strength and the lead scrunches down into the hole and as a result we've never had any leaks that I've noticed.

"Steel buildings are just the thing for cows because they stay tight and keep out wind and rain. We went through the rugged winter of '50-'51 without a single sick cow."

Ask any farmer who has a steel building and he'll tell you that you get more for your money when you build with steel.



**SEND THE COUPON**

United States Steel Company, Agricultural Extension Bureau  
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Please send me free literature about steel farm buildings.  
Building will be used for \_\_\_\_\_

Approximate size or capacity \_\_\_\_\_  
Send information to \_\_\_\_\_

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United States Steel Company is a steel producer, not a steel fabricator. Your request, therefore, will be sent to building manufacturers who fabricate steel buildings for farm use.

## U-S-S Galvanized Steel for Farm Buildings

*You get more for your money when you build with Steel*

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## Experimental Farms that "GROW" CONCRETE to build a stronger America

Two of the strangest farms in America "grow" concrete in northern Illinois and central Georgia. They are Portland Cement Association experimental farms where scientists study the effects of weathering on concrete in northern and southern climates.

"Growing" here are better pavements for barnyards and feedlots—better foundations, floors and walls for farm buildings, schools, hospitals, factories and other structures vital to America's welfare.

"Plantings" made on the farms, starting in 1940, consist of rows of concrete slabs, posts and boxes which simulate pavements, structural columns and walls. Specimens contain varying proportions and combinations of materials used in making concrete.

Such research is a continuing activity of the PCA. Out of it comes technical data on the best concrete mixtures and construction practices for installations exposed to all conditions of service and weather. Knowledge gained is made public immediately and freely through PCA's field engineering, educational and promotional programs made possible by the voluntary financial support of its 68 member companies.

Thus data from laboratory and field tests can be quickly used by agricultural engineers and contractors in designing and building more durable, lower-annual-cost facilities to keep America strong.

## PORTLAND CEMENT ASSOCIATION

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A national organization to improve and extend the uses of portland cement and concrete... through scientific research and engineering field work

## NEWS SECTION (Continued from page 230)

### ASAE Committee on Extension Invites

**E**XTENSION agricultural engineers and commercial education program directors are invited to swap "tricks" by participation in the demonstrations and exhibits activity of the ASAE Committee on Extension to be held in connection with the Society's annual meeting—this year June 16 to 18 at Kansas City, Mo. Those who are engaged in the educational or promotional phases of agricultural engineering are especially invited to take part in this program. Following are the exhibit classifications, the chairmen that interested persons should contact for entry rules, and information and examples of previous awards:

**Better Bulletins and Classroom Manuals** (M. R. Dunk, Sandstone Bldg., Mount Morris, Ill.) Two classifications: (1) "industrial" and (2) "public agency". Entries must be turned in by May 20, 1952. Examples of recent awards: "Plans for Cattle Feeders and Equipment," Oklahoma A. & M. College; "Electrical Farm Equipment You Can Build," Westinghouse Electric Corp.

**Master Movies** (I. D. Mayer, Agricultural Engineering Bldg., Purdue University, Lafayette, Ind.) Films will need to be sent before May 1st to allow time to decide on winners before ASAE annual meeting. Examples of recent awards: "Right as Rain," Aluminum Co. of America; "Revere System of Rural Piping," Revere Copper and Brass, Inc.

**Slides Sets and Film Strips** (S. S. DeForest, Agricultural Engineering Bldg., Iowa State College, Ames). Examples of recent awards: "Safe Power," G. I. Johnson, University of Georgia; "Tile Drainage on the Farm," Structural Clay Products Institute.

**Demonstration Models** (F. W. Andrew, Agricultural Engineering Bldg., College of Agriculture, Urbana, Ill.) There are two classifications: (1) portable and (2) stationary. Examples of recent awards: "Solarimeter," Libbey-Owens-Ford Glass Co.; "Farmstead Planning Aids," University of Illinois.

**Charts and Posters** (G. I. Johnson, Agricultural Engineering Bldg., University of Georgia, Athens). This is a new exhibit classification.

**Press and Radio Releases** (Dale O. Hull, Agricultural Engineering Bldg., Iowa State College, Ames).

**New Textbooks** (J. P. Schaefer, 1116 S. 28th St., Arlington 2, Va.) Exhibit limited to academic textbooks written by agricultural engineers and issued by publishers, and does not include manufacturers' manuals. No awards offered.

**Safety Exhibits** (R. E. Heston, 2105 N. Meridian St., Indianapolis 7, Ind.) Three classifications: (1) demonstration aids on farm and home fire safety, (2) demonstration aids on farm and home accident safety, and (3) report on farm and home accident safety. No recent awards.

The ASAE Committee on Extension is preparing a guide for producing educational material to meet the Committee's standards. Those planning educational publications or aids should find it helpful. A copy may be obtained from the Committee chairman, K. H. Hinchliff, Agricultural Engineering Bldg., College of Agriculture, Urbana, Ill.

The program being sponsored by the Committee on Extension in connection with the ASAE annual meeting in Kansas City in June will feature a demonstration on sound equipment. Eugene Carrington, educational director of Allied Radio, is scheduled to demonstrate new and unusual equipment of this type.

### Chemurgists Consider an Expanding Agriculture

**M**ECANICAL and chemical engineers should come to the aid of agricultural engineers in giving farm production the help of engineered equipment and operating methods, according to one speaker at the 17th annual Chemurgic Conference, March 11 and 12, at St. Louis, Mo.

The speaker, Dr. W. S. Gillam of the Midwest Research Institute, Kansas City, Mo., gave agricultural engineers due credit for their contributions to modern agriculture, but indicated that the total number of agricultural engineers is small in proportion to the variety and extent of engineering problems involved in the production and handling of agricultural commodities. He was speaking on the subject, "An Engineer's Look at Chemurgy."

Direct reference to agricultural engineering by the industrialists, farmers, chemists, and other scientists was limited. They did, however, make numerous references to such agricultural engineering matters as equipment, operations, and structures as factors in the farm production, harvesting, and handling of such chemurgic materials as cellulose from farm woodlots, corn and soybeans, other oil seed crops, fiber crops, and some of the miscellaneous present and potential farm sources of other organic chemical materials.

Considerable interest was shown in a recently publicized synthetic additive for improving the physical condition of soils for crop production, moisture conservation and erosion control purposes.

(Continued on page 234)

# Invents Machines to Clear Land of Stumps at Low Cost!



**SELF-PROPELLED STUMP BORER**

Bert Corbello demonstrates his novel stump rooter. No matter whether a stump is "bulldozed" or dynamited, some roots always remain. Mr. Corbello's hydraulic-operated "rooter" pulls up these remaining roots so that the land is entirely cleared for crops. Mr. Corbello's machines have enabled him and his brothers to clear acres of land at low cost.

**STUMP ROOTER**



This machine, designed and built of parts of old automobiles by Bert Corbello, R.D.2, Kinder, La., bores holes in large stumps at the proper angle for effective dynamiting, at the rate of 3 feet deep per hole per minute. The operator does not have to leave the machine and in a short time can drill many stumps for dynamiting.

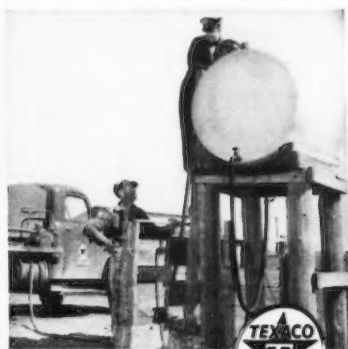
**B**ERT CORBELLO and his two brothers leased 2,000 acres for rice farming near Lake Charles, La. A considerable portion of the land had to be cleared of sizable trees. Thanks to Bert's inventive genius in developing the stump borer and stump rooter shown, plus Texaco Products, the Corbello brothers cleared the land at rock bottom cost. Now it is paying a good dividend.



"Jane Ormsby," oldest registered Holstein cow in U. S., is 24, an age equivalent to 170 among humans. She was bred and is owned by Charles Brace (left) and his brother, Don, of Lone Rock, Wisc. The Braces find that Marfak lubricant sticks to bearings better and longer — seals out grit and dirt — won't wash off, drip off, dry out or cake up.



Even "Billy" is interested, as Mr. Corbello opens up a bucket of Havoline, the Heavy Duty Motor Oil that practically eliminates engine wear in Diesels and heavy trucks, tractors and automobiles. Havoline keeps engines cleaner, better lubricated, therefore providing more power and pull from every drop of fuel.



Mr. Fred Buscher (left), who farms 780 acres near Ritzville, Wash., gets friendly, neighborly service from Texaco Man Paul Meyer. Mr. Meyer is delivering a tankful of Fire-Chief, the gasoline with superior "Fire-Power" for low-cost operation. Farmers the country over find it pays to farm with Texaco Products.

**IT PAYS TO FARM WITH**

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*"It's BIGGER...  
in Power, Performance,  
Economy!"*

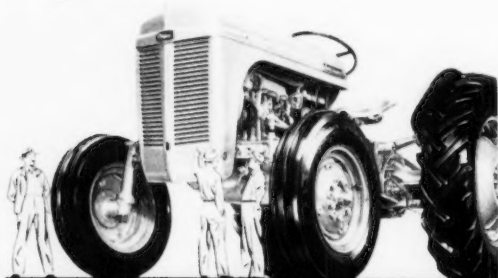
*"It meets MORE of  
my needs MORE of  
the time!"*

**THE FAR MORE POWERFUL  
FERGUSON "30"**

When these farmers saw the new Ferguson "30" walk away with three 14-inch bottoms in tough sod, they wondered where all this power came from. Even their ears fooled them, for the Ferguson engine is deceptively quiet... a tribute to precision engineering. The secret of Ferguson power, of course, is a new valve-in-head engine with far greater power and torque. And this power, combined with the one and only Ferguson System, gives a range of performance on all farm jobs that is unmatched by any other tractor!

**Get a  
"Showdown" Demonstration!**  
Your friendly Ferguson Dealer will be proud to demonstrate this performance on your farm... on heavy jobs as well as light ones.

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**FERGUSON TRACTOR  
AND 63 FERGUSON SYSTEM IMPLEMENTS**

## NEWS SECTION (Continued from page 252)

### Another A-E Milestone in Michigan

ACCORDING to word just received from A. W. Farrall, head, agricultural engineering department, Michigan State College, another agricultural engineering milestone has been reached in Michigan. Mr. Farrall quoted from a letter he had just received from H. G. Groehn, executive secretary, State Board of Examiners for Professional Engineers, State of Michigan, as follows: "The State Board, after due consideration of the request made by Michigan State College, ruled that in June, 1952, the State Board would conduct examinations for professional engineers with the subtitle 'Agricultural'."

### Hawaii Section Program

A TALK illustrated with colored slides was made at the February 6 meeting of the Hawaii Section of the American Society of Agricultural Engineers, by W. W. G. Moor of American Factors, a Honolulu business house, based on his recent trip through the sugar-cane-growing regions of South and Central America, which those in attendance found of outstanding interest. Another feature of the program was a sound movie in color, entitled: "Principles of Automatic Control."

### World-Wide Scope of Engineering Centennial

FIRST indication of world-wide scope of the Centennial of Engineering to be celebrated in Chicago this summer was the announcement that leading scientific societies of seven nations (other than the USA) have pledged active participation. These are in addition to the 39 American scientific and engineering bodies previously announced.

In each case the organizations of other countries have agreed to send sizable delegations of their best-known figures to this country for the 10-day convocation, September 3 to 13, for the specially created public exhibit of world engineering progress in the past 100 years, and for the spectacular stage presentation to be included in the Centennial program. Delegations representing other countries will include the Royal Society of Industrial Engineers of Belgium, the Japanese Society of Civil Engineers, the Institution of Civil Engineers and the Institution of Mechanical Engineers both of Great Britain, the World Power Conference, and the Engineering Institute of Canada. European engineering societies, as well as those of Latin and Central America, will have leading parts in the ceremonies planned for the International Day program scheduled to open the convocation meeting on September 3.

### Recognition in New Hampshire

ALUMNI of the University of New Hampshire, in the January "Alumnus", were introduced to agricultural engineering as one of the newer professional curriculums offered by the University. A three-page article summarized the history, facilities, professional training and other work of the department.

In closing, the article pointed to the need and opportunity for additional agricultural engineers and suggested that the alumni encourage appropriate high school students to consider training for careers in this field.

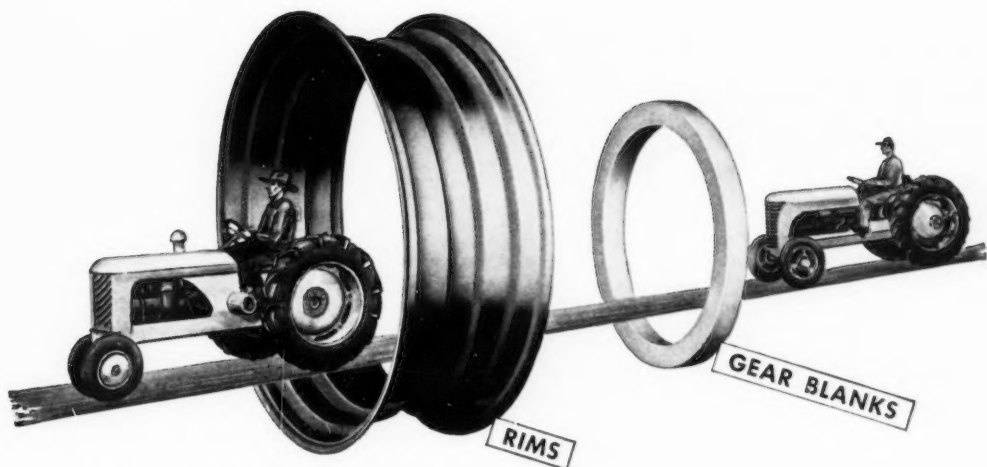
### Grassland Congress in August

THE Sixth International Grassland Congress will be held at Pennsylvania State College from August 17 to 23. The previous five congresses have been held in Europe, and this is the first to be held in the United States.

The U.S. Departments of State and Agriculture and the Food and Agriculture Organization of the United Nations (FAO) are sponsoring this Congress, which will provide an opportunity for scientists and technicians from various parts of the world to exchange information concerning the production, improvement, management, and use of grassland. The agencies in the United States which are cooperating in making arrangements for the Congress are the Departments of State, Agriculture, and the Interior, the Mutual Security Agency, the land-grant colleges and universities, and interested national trade organizations and technical societies.

The program for the Congress provides for holding sectional meetings to discuss various major topics relating to grassland. The topics selected are as follows: (1) genetics and breeding, (2) improvement and management of pastures, meadows and turf, (3) improvement and management of range land, (4) ecology and physiology of grasslands, (5) soil management and fertilization, (6) seed production and distribution, (7) soil and water conservation, (8) harvesting and preservation of forage, (9) use of forage and livestock feeding, (10) machinery, (11) experimental procedures in grassland research, and (12) improvement and management of tropical grasslands.

All inquiries and correspondence regarding the Congress should be addressed to W. R. Chapline, executive secretary, Organizing Committee, Sixth International Grassland Congress, Department of State, Room 1049, 1778 Pennsylvania Ave., N.W., Washington 25, D.C.



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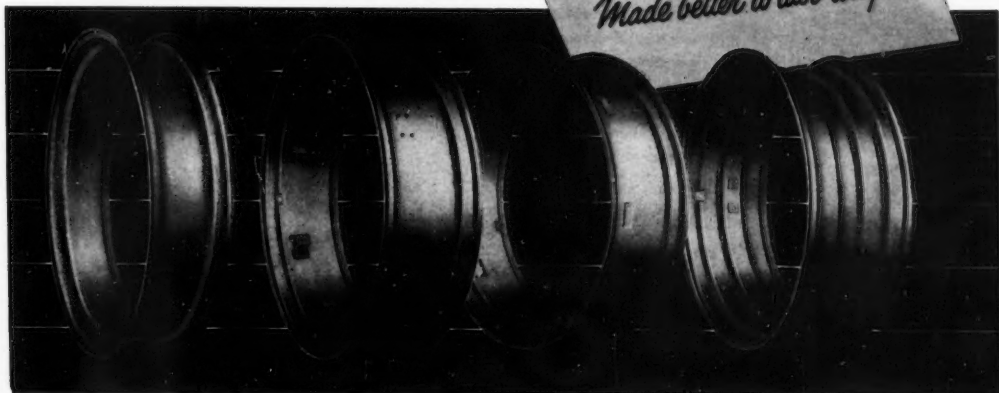
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This tractor-mounted Marlow Model 4605B centrifugal pump is used by Mr. Tyler of Vernon, Vermont. With it he applies approximately 300 GPM of water per setting in his pastures through 1000 feet of irrigation pipe and 12 sprinkler heads.

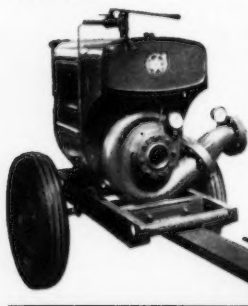
"More than satisfied," says Mr. Tyler. "So much so I've since bought another Marlow."



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## Indian Society of Agricultural Engineers

To the Editor:

ANOTHER dream of Mason Vaughn, professor of agricultural engineering and head of the agricultural engineering department, Allahabad Agricultural Institute at Allahabad, U.P., India, came true when 50 odd agricultural engineers and 40 to 50 agricultural engineering students met at the Institute on January 14 and 15. This was the first professional meeting of agricultural engineers held in India, and no effort had been made to get out a large crowd for the occasion. However, interest in the meeting ran high and culminated in a vote by the group to organize what is to be known as the "Indian Society of Agricultural Engineers".

An executive committee consisting of Mr. Vaughn, R. N. Pahlwan, test engineer, Implement Testing Station, U.P. Government, and S. V. Arya, assistant professor of agricultural engineering, Benares Hindu University, Benares, was appointed to draft a proposed constitution and by-laws by which the new society will be governed.

M. K. Nandi, agricultural engineer in charge of the Uttar Pradesh Tractor Workshop at Bareilly, was elected president of the new society, and S. C. Bhatnagar, agricultural engineer in charge of the U.P. Tractor Workshop, Lucknow, was elected secretary-treasurer. Both Mr. Nandi and Mr. Bhatnagar are agricultural engineering graduates of Allahabad Agricultural Institute.

Until recently India has had to depend almost entirely on mechanical and civil engineering graduates to handle assignments in the field of agricultural engineering. These men have done and are still doing excellent work, and a considerable number of them have earned advanced degrees in agricultural engineering in universities of other countries.

Mason Vaughn came to India as professor of agricultural engineering at the Allahabad Agricultural Institute in 1921. Since that time he has seen interest in the agricultural engineering profession make substantial growth in India. For over 20 years he has taught agricultural engineering subjects to agricultural students. In 1944 the Institute graduated its first class with the degree of bachelor of science in agricultural engineering. Since that time about 100 students have earned their degree in agricultural engineering from that institution. It is still the only school in India offering a course leading to a professional degree in agricultural engineering, however, plans are now under way for at least one government institution to enroll students in a professional agricultural engineering curriculum in the near future. Most of the agricultural schools in the country are now offering some courses in agricultural engineering.

Extension agricultural engineering adviser  
to the Government of India,  
c/o American Embassy, New Delhi, U.P., India

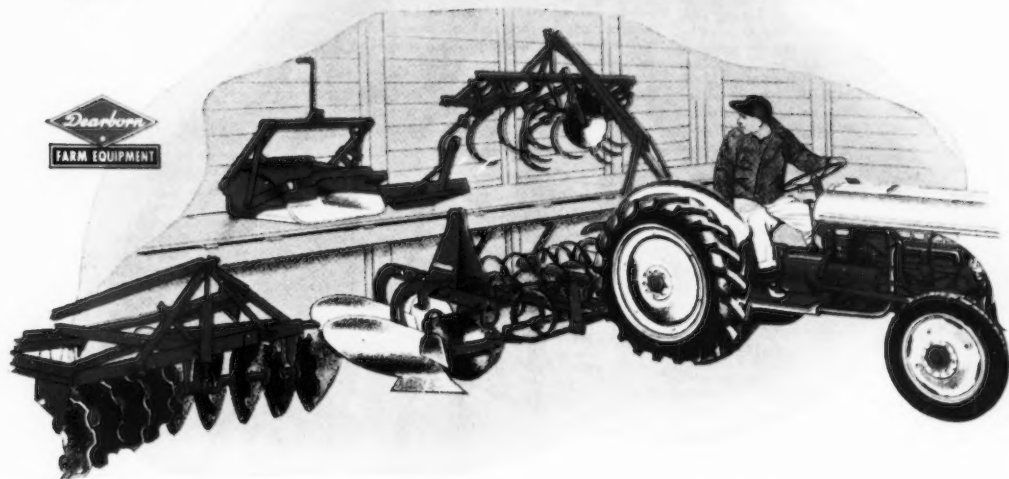
EARLE K. RAMBO



In the top view (above) is part of the group of agricultural engineers and agricultural engineering students that attended the organization meeting of the new Indian Society of Agricultural Engineers formed at Allahabad in January. In the group below are (standing, left to right) S. V. Arya and R. N. Pahlwan and (seated, left to right) S. C. Bhatnagar, Mason Vaughn and M. K. Nandi.

# Bunk Beds

## FOR IMPLEMENTS!



To anyone driving along rural highways, the sight of implements standing around in barnyards or open fields is apt to suggest carelessness or neglect.

But, as farm folks well know, the proper storage of implements is a tough problem. It costs money to leave them out, exposed to the weather. It also costs plenty to provide adequate, convenient storage facilities.

And, with the increase in mechanization of farm work and the rising costs of building, this implement storage problem is apt to get worse before it gets better.

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*AGRICULTURAL ENGINEERING for April 1952*

## *Ford Farming*

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## NEW BOOKS

**TRACTORS AND THEIR POWER UNITS**, by E. J. Barrett, W. M. Carleton, E. G. McKibben, and Roy Bainer. Cloth, viii + 496 pages, 5 1/2 x 8 1/2 inches. Illustrated and indexed. John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. \$6.50.

This is an advanced engineering text of the type intended to help upper class students extend their comprehension of engineering principles while gaining practical knowledge of the application of those principles in a specific field. Incidentally, it should prove a valuable reference for practicing engineers in farm equipment and related fields. It is the second of the Ferguson Foundation Agricultural Engineering Series. Chapters cover history and

development of the tractor, power and power measurement, thermodynamic principles of internal combustion engines, internal combustion engine cycles, valves and valve timing, fuels and combustion, tractor fuels, carburetion and fuel induction, ignition systems, engine cooling and cooling systems, lubrication and lubrication systems, dirt exclusion, governors, engine types and development, factors affecting engine performance, design features of the tractor engine, operator's comfort, convenience, and safety, mechanics of the farm tractor chassis, hitches, clutches and brakes, transmissions, differentials, and final drives, power take-off, belt pulley, power lift, and hydraulic controls, traction and traction devices, tractor tests and performance, tractor maintenance and repair, and tractor power cost estimating. An appendix presents tire and rim data, calcium chloride

tablets, ASAE Standards, and operated machine draft and power requirements.

**MODERN AMERICAN ENGINEERS**, by Edna Yost. Cloth, ix + 182 pages, 5 1/2 x 8 inches. J. B. Lippincott Co. (East Washington Sq., Philadelphia, Pa.) \$2.50.

A biographical approach to better understanding of engineers and engineering, this book aims to interpret the profession primarily to young people of the 12 to 18-year age group—the age of decision on future careers. It recognizes the need and opportunity for engineers in the world of today and the future. It will provide inspiration and guidance to those who may be attracted to careers in engineering. Notably it will show the progressive steps in the lives of a few men, by which each progressed from normal boyhood and some uncertainty as to what he should try to make of his life, to a maturity of outstanding success in some branch of engineering.

Each of 12 chapters presents in interesting narrative form the primary biographical features in the life of one man so far as his professional career is concerned. Agricultural engineering is appropriately represented by the biography of J. Brownlee Davidson. This places him, and the agricultural branch of engineering, in company with such noted representatives of other branches of engineering as Robert Ernest Doherty, engineering educator; Ralph Edward Flanders, mechanical engineer and U.S. Senator; Arthur Ernest Morgan, civil engineer and authority on flood control; Vannevar Bush, electrical engineer, president of the Carnegie Institution, and head of scientific research and development for the United States in World War II; Scott Turner, mining engineer; Harold Bright Maynard, industrial engineering consultant; Ole Singstad, civil engineer and designer of the Holland Tunnel; John Robert Suman, petroleum engineer; Carl George Arthur Rosen, research engineer; Stanwood Willston Sparrow, automotive engineer; and Harold Alden Wheeler, radio and television engineer.

**HEATING, VENTILATING AND AIR CONDITIONING GUIDE**, 1952 (30th edition). Cloth, xiv + 1496 pages, 6 x 9 inches. Illustrated and indexed. American Society of Heating and Ventilating Engineers (62 Worth St., New York 13, N. Y.) \$7.50.

Technical and manufacturers catalog data sections. Subsection and chapter headings and arrangement in the technical data section are substantially the same as for last year's edition. Previously published material has been condensed to the extent of 16 pages. This space and 16 additional pages have been filled with new material. Information has been brought up to date, with substantial changes indicated in the chapters on heat transfer, heat transmission coefficients of building materials, heating load, cooling load, fuels and combustion, heating boilers, furnaces, and space heaters, chimneys and draft calculations, estimating fuel consumption for space heating, steam heating systems, radiators and convectors, unit heaters and unit ventilators, unit air conditioners and unit air coolers, fans, air cleaning, refrigeration, industrial air conditioning, and codes and standards.

**FARM MECHANIZATION DIRECTORY**, 1951. Second edition. Paper, ix + 504 pages, 5 1/2 x 8 1/2 inches. Temple Press, Ltd. (Bowling Green Lane, London EC11) Six shillings net.

A guide for buyers of mechanical farm equipment throughout the world, covering primarily products available in the United Kingdom, and in most cases also manufactured there. It includes a list of British organizations interested in farm mechanization, an index of manufacturers, index of trade names, a classified directory, and an index to classifications.



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## NEW BULLETINS

**Power Farming—A Way of Life.** Oil Industry Information Committee, American Petroleum Institute (50 West 50th St., New York 20, N. Y.). In a matter of 18 pages this bulletin traces progress in farm power from man and animals to the modern farm tractor. It relates this power progress to increases in the quantity and variety of man's productivity, to the evolution from bare subsistence to today's accepted standards of living. It should prove helpful in interpreting the practical significance of our technical and industrial progress to many of its non-technical beneficiaries, and to high school and college students. Single copies will be furnished free on request to teachers of agricultural engineering

and of vocational agriculture, and to all interested extension personnel. Lots of 10 will also be furnished free to individual vocational agriculture departments.

**Environmental Physiology, with Special Reference to Domestic Animals.** by R. E. Stewart, L. E. Pickett, and Samuel Brody. Missouri Agricultural Experiment Station (Columbia) Research Bulletin 484 (October, 1951). Among reports of continuing studies under the same general title, this bulletin deals specifically with Section XVI Effect of Increasing Temperatures 65° to 95° F., on the Reflection of Visible Radiation from the Hair of Brown Swiss and Brahman Cows.

**Buildings for the Dairy Enterprise.** by J. C. Wooley, K. B. Huff, R. E. Stewart, and A. C. (Continued on page 241)

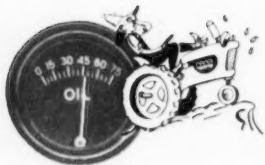
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## Applicants for Membership

The persons listed below have applied for admission to membership or for transfer of membership grade, in the American Society of Agricultural Engineers. Members of the Society who wish to commend or object to any of these applicants, should write the Secretary of the Society at once. If there are no objections, and if confidential statements furnished by their references are satisfactory, these applicants will be voted on by the Council after May 15, 1952.

- AKHTAR, AHMAD—Supt., agr. workshop, Punjab Agr. College, Lyallpur, Pakistan  
ALBRIGHT, CHARLES M.—Product spec., International Harvester Co., Chicago, Ill.  
BASS, ROBERT G.—Student, Virginia Polytechnic Inst., Blacksburg, Va.  
BENFORD, HAROLD—Assoc. editor, The Progressive Farmer, Birmingham, Ala.  
BOHMER, JAMES S.—Div. sales mgr., John Deere Plow Co., San Francisco, Calif.  
BUTLER, GEORGE W.—Pres., George Butler Co., Chicago, Ill.  
CURVEY, M. O.—Mgr., tillage machinery sales, International Harvester Co., Chicago, Ill.  
DEBUSK, KENNETH E.—Student, Virginia Polytechnic Inst., Blacksburg, Va.  
DOUGLAS, JAMES M.—Student, Virginia Polytechnic Inst., Blacksburg, Va.  
FANCEY, STEPHEN—2276 Gladstone Ave., Windsor, Ont., Canada  
HENKE, THOMAS G.—Student, Virginia Polytechnic Inst., Blacksburg, Va.  
MITCHELL, CHARLES W.—Product spec., International Harvester Co., Chicago, Ill.  
NOBLE, THOMAS E.—Student, Ontario Agricultural College, Guelph, Ont., Canada  
ROBERTS, LAURENCE G.—Supervisor, tractor and ind. eng. div., Ford Motor Co., Highland Park, Mich.  
ROBERTSON, WILLIAM T., JR.—Student, Virginia Polytechnic Inst., Blacksburg, Va.  
ROWLETT, EDWARD G.—Dist. engr., The Torrington Co., Davenport, Iowa  
SANDERS, PAUL G.—Student, Virginia Polytechnic Inst., Blacksburg, Va.  
SELING, ARNOLD F.—Design engr., French & Hecht Div., Kelsey-Hayes Wheel Co., Davenport, Iowa  
SHEPHERD, PHILIP A.—Student, Virginia Polytechnic Inst., Blacksburg, Va.  
SMITH, J. C.—Asst. mgr. of tillage machinery sales, International Harvester Co., Chicago, Illinois  
STIMSON, RALPH J.—Layout draftsman, tractor eng., Ford Motor Co., Dearborn, Mich.  
STRAIM, GEORGE H.—Chief engr. of spray equip., A. B. Farquhar Co., York, Pa.  
STROUT, THOMAS J.—Jr. engr., Dearborn Motors Corp., Birmingham, Mich.  
VREELAND, ALVIN M.—Product spec. of grain harvest machines, International Harvester Co., Chicago, Ill.  
WAGNER, RICHARD F.—Design engr., French & Hecht Div., Kelsey-Hayes Wheel Co., Davenport, Iowa  
WALCOTT, PHILIP J.—Student, Michigan State College, East Lansing, Mich.  
WALTON, WILLIAM P.—Sales trainee, Florida Ford Tractor Co., Jacksonville, Fla.  
WECKSTEIN, SAMSON M.—Chief engr., ind. div., Timken Roller Bearing Co., Canton, Ohio  
ZAHN, GEORGE—Sales mgr., Stewart-Warner Corp., Chicago, Ill.

## TRANSFER OF MEMBERSHIP GRADE

- GUNKEL, WESLEY W.—Asst. prof. of agr. eng., Cornell University, Ithaca, N. Y. (Associate Member to Member)  
STAGERS, ENNES D.—Layout draftsman, International Harvester Co., East Moline, Ill. (Affiliate to Member)

## NEW BULLETINS

(Continued from page 240)

Ragsdale, Missouri Agricultural Experiment Station (Columbia) Bulletin 559 (September, 1951). Recommended layout and structural features for milking rooms, loose housing and grouping of buildings.

Specifications for the Combination Milking Barn and Milk House, by K. B. Huff, R. E. Stewart, J. E. Edmondson, J. L. Rowland, and John H. McCutcheon. Missouri Agricultural

Extension Service (Columbia) Circular 606 (November, 1951). Presents basic requirements and recommendations approved jointly by the Missouri State Division of Health, the Missouri Milk Sanitation Advisory Council, and the Missouri College of Agriculture. While it refers specifically to approved and available plans for three combination buildings it indicates that these plans may be modified or other plans used so long as the indicated basic requirements are satisfied.

Electricity on Farms in Southwestern Kan-

as, by C. F. Bortfeld and Joe F. Davis. Kansas Agricultural Experiment Station (Manhattan) Bulletin 551 (December, 1951). Reports economic studies of farm electric use as influenced by competing sources of energy, progressive increase in numbers of farms connected and in use per farm, income, types of farms, sizes of farms, and tenure of operators. Continuing substantial increases in use in the area studied are indicated, subject to five reasonable assumptions as to economy and availability.

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## Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency, or registration, or license as a professional engineer.

**NOTE:** In this bulletin the following listings still current and previously reported are not repeated in detail, for further information see the issue of AGRICULTURAL ENGINEERING indicated.

**POSITIONS OPEN:** 1951—OCTOBER—O-401-544. DECEMBER—O-475-550, 480-551. 1952—JANUARY—O-484-553. FEBRUARY—O-503-556, 502-557. MARCH—O-537-558, 548-559, 552-560, 559-561, 576-562.

**POSITIONS WANTED:** 1951—OCTOBER—W-591-78. DECEMBER—W-459-81, 464-82, 461-83, 454-84, 477-89. 1952—FEBRUARY—W-504-92, 487-93, 528-95, 529-96. MARCH—W-514-97, 525-99, 538-100, 542-102, 560-105, 566-104, 573-105, 564-106.

#### NEW POSITIONS OPEN

**DESIGNER:** agricultural or mechanical engineer for improvement and new design equipment manufacturing in the East. College degree and at least two years experience. Must be neat, efficient and adaptable. Opportunity commensurate with ability. Salary open. O-594-563.

**RESEARCH ENGINEER (assistant):** for research and teaching in farm power and machinery, in an agricultural college in eastern Canada. Research will include field experimental work primarily on tillage and harvesting machinery. BS deg. in agricultural engineering or equivalent and MS deg. with major in farm machinery. Farm background. Must be good cooperater with initiative and willingness to work. Physically fit for field work. Good opportunity for growth and promotion. Age 25-35. Salary open. O-592-564.

**RESEARCH ENGINEER (assistant):** for rural electric research and teaching in an agricultural college in eastern Canada. BS deg. in agricultural or electrical engineering, and MS deg. in field of rural electrification. Experience in extension or research in field, or in wiring or other electrical contract work desirable. Good character, physical condition, and personality, able to cooperate. Good opportunity for development work and promotion. Age 25-35. Salary open. O-596-565.

**ASSISTANT PROFESSOR:** of agricultural engineering, to teach senior college level academic courses in farm shop, machinery, motors, electrification, and field operations. Eastern location. BS or MS deg. in agricultural engineering, or equivalent. Extensive experience in farm machine operation and ability to teach. Opportunity for advancement toward department head position. Salary open. O-584-566.

**GRADUATE ASSISTANTSHIP (research):** in irrigation engineering, for work on engineering phases to be coordinated with related work on agronomic phases, in a North Central state. BS deg. in agricultural engineering or equivalent, with good scholastic record. Farm background and interest in irrigation farming. Opportunity to earn MS deg. while gaining research and practical experience. Appointment as soon as possible after June 15. Salary \$1520 per year on half-time basis, with additional pay for full time summer employment. O-602-567.

**GRADUATE ASSISTANTSHIP (research):** in rural electrification, for work on one of several established projects, in a North Central state. BS deg. in agricultural engineering or equivalent, with good scholastic record. Farm background and an interest in rural electrification problems. Opportunity to earn MS deg. while gaining research and farm electrification experience. Appointment about June 15 or as soon after as possible. Salary \$1520 per year (12 mo. half-time basis). O-603-568.

**ASSOCIATE EDITOR:** established farm equipment trade paper, to write reports of meetings and interviews, describe operations of dealers and manufacturers, and handle other editorial staff duties. Prefer man with BS deg. in agricultural engineering or equivalent with writing experience. Additional experience in farm equipment sales or mechanized farming helpful. Must be able to handle detail work, work with figures quickly and accurately, express himself clearly in writing, and meet deadlines. Salary \$7,500 range and bonus. O-610-569.

(Continued on page 244)

## PROFESSIONAL DIRECTORY

**FRANK J. ZINK ASSOCIATES**  
Agricultural Engineers

Frank J. Zink Wendell C. Dean Earl D. Anderson

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**RATES:** Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of \$1.00 per line per issue; 50 cents per line to ASAE members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

**K<sup>now</sup> H<sup>ow</sup>** and RESPONSIBILITY  
are behind  
"WHEELS by F & H"

Our constant search for wheel improvement takes ALL factors into account—



- The design of WHEELS and HUBS
- The design of SPINDLES and AXLES
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- Selection of suitable closure SEALS
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DIVISION**

KELSEY-HAYES WHEEL COMPANY  
DAVENPORT, IOWA

## Farm Machinery Designers

Graduate Engineers, Mechanical or Agricultural, with farm machinery background, that are interested in the design and development of Harvesting equipment.

Openings in an expanding Engineering Department for all grades including recent graduates or those with years of experience. Opportunity for advancement for those who wish to join a progressive organization.

Ideal Engineering facilities, located in a small city in the Midwest.

Salaries commensurate with education, experience, and background.

Address box number NI-52, c/o Agricultural Engineering, St. Joseph, Michigan.



# GALVANIZED SHEETS

**For PROTECTION** Only galvanized sheets give you the strength of steel... the rust protection of zinc. Both are important in providing a strong, sound, leak-proof roof that double-guards valuable crops, livestock and machinery against damage and destruction for years and years. It's the first choice of farmers.

**For STAYABILITY** Galvanized roofing holds at the nail holes... stays leak-proof and solid year after year with a minimum of maintenance. Farmers say it cuts down overhead by staying "overhead"—often for the life of the building.

**For ECONOMY** Consider the economy of any roofing material with these three long-time cost factors in mind: (1) original price; (2) repair and upkeep; (3) years of serviceable life. Galvanized sheets are first choice of farmers because they know that the roof that gives them the longest, trouble-free service is the cheapest in the long run.

### DON'T FORGET

Proper care pays! Material shortages are limiting new construction and replacement. Careful maintenance of present structures is more essential now than ever before. Expanding production of zinc and steel means ample supplies of

galvanized sheets with the return of more normal conditions. In the meantime, a few simple steps with very little labor can extend the useful life of your galvanized roofing. The valuable booklets described below will tell you how.



**SEND  
FOR  
VALUABLE  
BOOKLETS**

#### AMERICAN ZINC INSTITUTE

35 E. Wacker Drive, Room 2602  
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Without cost or obligation, send the illustrated booklets I have checked.

- ☐ Facts About Galvanized Sheets
- ☐ List of Metallic Zinc Paint Mfrs.
- ☐ Directions for applying Galvanized Sheets
- ☐ Repair Manual, on Galvanized Roofing and Siding
- ☐ Use Metallic Zinc Paint to Protect Metal Surfaces

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## FOR FARM AND INDUSTRY

# ELECTRIC

## WHEELS ARE RIGHT

Over 65 years in wheel manufacturing have given us the "know how"—modern production methods assure long life and efficient wheel performance in the field.

There is an ELECTRIC spoke or disc wheel for most types of portable equipment. Axles are available where required.

Our experienced engineers are ready to assist you in solving your wheel and axle problems and we will offer our recommendations upon receipt of your specifications.

**WRITE FOR CATALOG**  
**ELECTRIC WHEEL CO.**  
**2811 CHERRY, QUINCY, ILL.**

## Personnel Service Bulletin

(Continued from page 242)

### NEW POSITIONS WANTED

**DESIGN.** teaching, or research in power and machinery or rural electrification, with college or manufacturer in California. Limited travel only. BS deg. in engineering (major in agricultural engineering). 1949. University of California. Additional study in electrical engineering by correspondence. Office and inside sales with electrical manufacturer 3 yr; sales engineering with electrical contractor, 1 1/2 yr. Soil Conservation Service, 8 mo; teaching, one year. War enlisted and commissioned service in U.S. Navy Reserve Air Corps. Married. Age 30. No disability. Available June 15. Salary open. W-588-107

**TEACHING** or research in power and machinery with a college in the Southeast. BS deg. in agricultural engineering 1949. University of Georgia. MS deg. in agricultural engineering, 1950. Kansas State College. Instructor in agricultural engineering subjects in vocational agriculture department. Southwest Texas State Teachers College, 2 yr. Graduate research assistant, one year. Farming 2 yr. Auto mechanic 2 yr part time. War enlisted service in Navy 2 yr as motor machinist mate. Married. Age 27. No disability. Available June 1. Salary open. W-590-108

**EXTENSION.** teaching or research in rural electrification in South or Midwest, with industry or public service. BS deg. in agricultural engineering. 1943. Louisiana State University. Farm background. With electric utility since 1946 as rural service, commercial sales, and dealer service representative, in turn. War enlisted, cadet, and commissioned service in communications, with Air Corps. Married. Age 30. No disability. Available on two weeks' notice. Salary open. W-592-109

**SALES.** service, or management in power and machinery or farm structures with manufacturer or distributor, anywhere in U.S.A. Willing to travel. BS deg. in agricultural engineering, 1950. University of Georgia. Experimental machine work, 2 yr. Ansco Camera Corp. Research and maintenance work part time 3 yr in college agricultural engineering department. With farm equipment manufacturer 6 mo in demonstration work, 1 yr. 9 mo as district sales manager. War enlisted service in Navy nearly 3 yr, with promotions to AAM 2/c. Married. Age 28. No disability. Available now. Salary \$4500. W-600-110

**DESIGN** and development as project engineer or assistant to chief engineer with a farm machinery manufacturer anywhere in the United States, or possibly outside the United States. BS deg. in agricultural engineering, 1943. Michigan State College. Eight years farm machinery design experience, including the design of three machines now in production. Capable of accepting the responsibility of design, supervision of construction, field testing, and placing in production a new piece of machinery. Currently employed as senior agricultural engineer developing a direct-mounted sugar cane harvester. Married. Age 33. No disability. Available on reasonable notice. Salary open. W-612-111

## Will Buy: SMALL MANUFACTURING COMPANY

Leading manufacturing corporation will consider the purchase of several small manufacturing companies with accepted products now being marketed in the automotive, tractor, farm machinery or implement field.

All names will be held in strictest confidence.

Please submit complete details regarding your facilities, products, etc.

**DO NOT DISCLOSE INVENTIONS THAT HAVE NOT BEEN PATENTED.**

Reply to Box BP-2, c/o Agricultural Engineering, St. Joseph, Mich.

## Unusual Opportunity for an Ag. Engineer

A position is available in the editorial department of a long-established agricultural paper. Some of the essential requirements are:

A farm and agricultural engineering background—ability to handle detail work—to work with figures quickly and accurately—to be able to express oneself clearly so as to write reports of meetings, of interviews, and to describe appraisingly advances in farm methods and equipment. Above all, the man who fills this position must be able to meet a deadline.

Address Box AE-52, c/o Agricultural Engineering, St. Joseph, Michigan.

## New Departure operates guns-and-butter plants

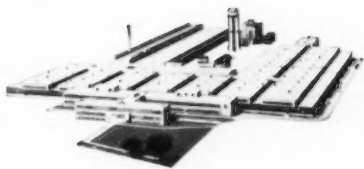


Ball bearings are essential to the products of our industrial might.

The ball bearings that serve millions of automobiles, trucks, tractors, farm implements, electric motors and industrial machinery are of the same materials, the same heat treatment, the same methods of precision manufacture as those required for mechanized warfare and electronic instruments. Thus conversion from one to the other at New Departure is largely a matter of changing the emphasis on types and sizes.

The productive capacities of the world's largest ball bearing factories are your assurance of the best possible production of your requirements.

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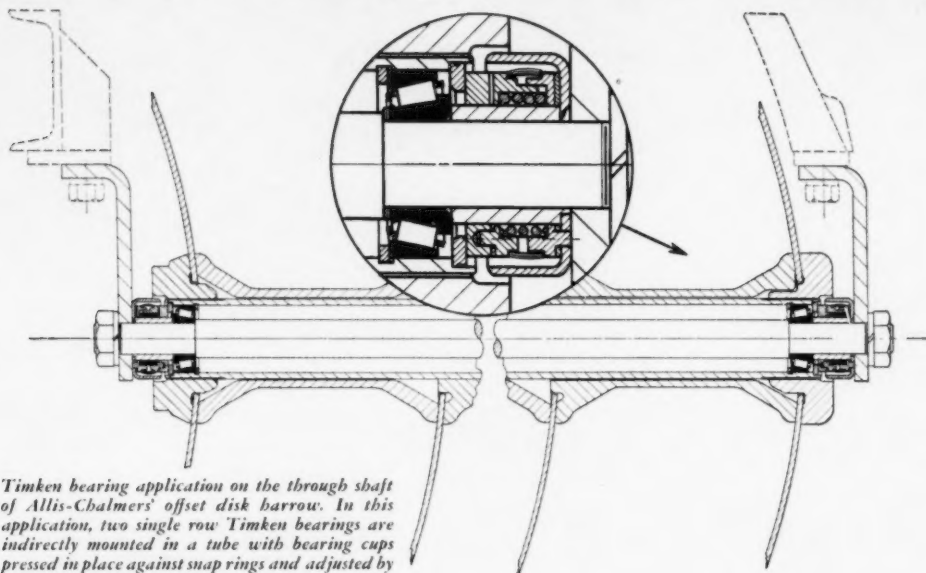
New Departure's plant at Sandusky, Ohio, where ball bearings are produced for both industry and the Armed Forces.

# NEW DEPARTURE

*Nothing Rolls  
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EVERY NEW FARM TRACTOR HAS TIMKEN BEARINGS; MORE AND MORE IMPLEMENTS ARE USING THEM, TOO!



*Timken bearing application on the through shaft of Allis-Chalmers' offset disk harrow. In this application, two single row Timken bearings are indirectly mounted in a tube with bearing cups pressed in place against snap rings and adjusted by means of shims between the cone and shaft shoulder.*

## How Allis-Chalmers used TIMKEN® bearings to solve 3 design problems at once



**B**y mounting the through shafts of this Model J offset disk harrow on Timken® tapered roller bearings, Allis-Chalmers engineers solved three of their biggest design problems—1) combination loads, 2) dirt, 3) ease of operation. Here's how:

Because of tapered construction, Timken bearings take radial and thrust loads in any combination. No extra thrust plates or bearings are required. Design problem number 1—*solved*.

Since Timken bearings keep housing and shaft concentric, they make closures more effective. Lubricant stays in—dirt and moisture stay out. Design problem number 2—*solved*.

The true rolling motion of Timken

bearings plus the smooth surface finish of rollers and races practically eliminate friction. Disk gang shafts turn easily, wear is minimized. Design problem number 3—*solved*.

More and more implement engineers are turning to Timken bearings to solve design problems. And as a result, implement users are assured of longer implement life, less chance of breakdown in the field, higher speeds, less frequent lubrication.

For more information about Timken bearings write now for your free copy of "Tapered Roller Bearing Practice on Current Farm Machinery Applications". The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

*The farmer's assurance  
of better design →*



NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION